2.0 AMMUNITION DEMILITARIZATION AND RENOVATION AREA

2.1 Declaration

This section provides the declaration portion of the ROD/RAP for the Ammunition Demilitarization and Renovation Area (ADRA).

2.1.1 Location

The ADRA is located in the southern portion of SIAD, approximately 1 mile north of Susanville Road (Figure 1.1).

2.1.2 Assessment of the Site

The distribution and extent of contamination at the ADRA was assessed based on activities conducted and data obtained during the 1991 Group II RI (JMM, 1992) and the 1993 Group I and II Follow-Up RI (Montgomery Watson, 1994). The results are summarized as follows:

- The potential source of contamination at the ADRA was discharges to two parallel sets of underground drainage pipes, septic tanks, and leach fields.
- No volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), or explosives were present at detectable concentrations in soil samples collected from test pits and two soil borings. No VOCs, SVOCs, or explosives were present at detectable concentrations in surface and subsurface soil collected from two soil borings. All metals present at detectable concentrations are interpreted to be naturally occurring.
- Low levels of VOCs were detected in two of four Hydropunch groundwater samples collected from the first 5 feet of the water table directly below the leachfield. Trace to low levels of VOCs have been detected sporadically during four of the six rounds of sampling of the three monitoring wells at the site. All levels were below the respective California or federal maximum contaminant levels (MCLs) for each compound.
- No explosives were detected in the four Hydropunch samples. Trace to low levels of explosives have been detected during three of six rounds of groundwater sampling.
- All metals and nitrate plus nitrite present in the groundwater at detectable concentrations are interpreted to be naturally occurring.

Potentially unacceptable risks to human health from the detected concentrations of arsenic in groundwater and soil were identified in residential exposure scenarios during a baseline risk assessment. However, the arsenic levels in the soil and groundwater at the ADRA are interpreted to represent native conditions. No adverse effects to ecological receptors at the ADRA were identified in the baseline risk assessment. Therefore, no further action is recommended at this site.

2.1.3 Description of the Selected Remedy

As discussed in the preceding section, no further action is recommended for the ADRA.

2.1.4 Statutory Determinations

Because no remedial actions are required at this site, no statutory determinations of remedial actions are necessary.

2.2 Decision Summary

This section provides the site-specific factors and analysis that were considered in the selection of the response action for the ADRA.

2.2.1 Site Description

The ADRA consisted of four buildings: Buildings 408 and 409, Boiler Plant No. 5 (Building 407), and a shower/bathroom facility (Figure 2.1). Buildings 408 and 409 and the shower/bathroom facility were torn down and the boiler plant was abandoned in 1974. Presently, two concrete platforms are all that remain of the original Buildings 408 and 409. The foundation of the shower/bathroom facility also remains. Each platform contained a floor drain that according to the SIAD general sewer map, led to an underground drainage pipe, septic tank, and leach field located south of the platforms (Figure 2.1).

The underground drainage pipes extend south from the concrete platforms beneath one set of railroad tracks and a chain-link fence. The septic tanks and leach fields are in a broad open space (Figure 2.1).

2.2.2 Site History and Enforcement Activities

The ADRA was active from 1958 to 1974. Operations carried out at the ADRA included ammunition pull-apart, repacking, and painting. Wastes generated were primers, charges, waste rags, paints, and solvents. Excess propellants were taken to the lower burning ground/demolition grounds, and solvents and paint sludges were taken to the burning pits at the old dump and fill area (Benioff, et al. 1988). Each platform contained a floor drain that, according to the base sanitary sewer map, led to an underground drainage pipe, septic tank, and leach field south of the platforms. It is possible that

small quantities of munitions compounds were washed down the drains; however, because this was not routine practice, the total volume is expected to be small (ESE, 1983).

Investigations conducted at the ADRA include the following:

- 1991 Group II RI, J.M. Montgomery Consulting Engineers, Inc. (JMM)
- 1993 Group I and II Follow-Up RI, Montgomery Watson

No soil contamination was detected along either of the leach field alignments during the 1991 Group II RI. The three monitoring wells that were installed during the 1991 Group II RI have been sampled for six rounds. The wells have had detectable concentrations of explosives and VOCs in some of the sampling rounds but at trace to low levels detected sporadically.

The 1993 Group I and II Follow-Up investigation of the ADRA focused on determining the presence of VOCs and/or explosives in the groundwater beneath the leach field at the site. During the 1993 Group I and II Follow-Up RI, four Hydropunch groundwater samples were collected from beneath the leach field lines in areas where contamination potential is high. Two of the Hydropunch groundwater samples contained low levels of VOCs.

No explosives were detected in any of the Hydropunch groundwater samples. Low levels of VOCs and explosives may have been present in the washwater disposed at the site, so low levels of these constituents are not unexpected. The levels detected were below the respective California or federal MCLs for each compound.

2.2.3 Highlights of Community Participation

One 30-day public comment period was held from February 7, 1996, to March 7, 1996. A public meeting was held at SIAD on February 22, 1996. Representatives of the Army, DTSC, and the Lahontan RWQCB were present at the meeting. Responses to site-specific questions raised by the public at this meeting are presented in Section 2.3 of this ROD/RAP.

The public participation requirements of CERCLA § 113(K)(2)(B)(i-v) and § 117, and § 25356.1 of the California Health and Safety Code were met in the remedy selection for this site. The response action presented for this site in this ROD/RAP was selected in accordance with CERCLA, NCP, Chapter 6.8 of the California Health and Safety Code, and California Water Code. The basis for this decision is documented in the Administrative Record.

2.2.4 Scope and Role of Response Action

This ROD/RAP presents the final response action for the ADRA. This site poses no potential threat to human health and the environment. The selected remedy is No Action. This will be the final action for the ADRA.

2.2.5 Site Characteristics

Contamination at the ADRA was suspected due to disposal of washwater and liquid wastes through the leach fields at the site. An assessment of potential contamination at the site was based on surface geophysical data, surface- and subsurface-soil analytical data, and groundwater analytical data.

2.2.5.1 Geophysical Survey

A geophysical survey was conducted during the 1991 Group II RI to locate the two leach field alignments associated with Buildings 408 and 409. Each alignment consisted of a buried sewer line, septic tank, and leach field (Figure 2.1). Ground penetrating radar (GPR) was the primary method used to locate the alignments.

2.2.5.2 Surface Soil

Two surface-soil samples were collected from the ADRA during the 1991 Group II RI. The samples were collected from the surface interval of soil borings ADR-01-SB and ADR-02-SB (Figure 2.1). These samples were analyzed for California Title 22 metals, VOCs, SVOCs, and explosives.

The metals detected in surface soil are interpreted to be naturally occurring (Table 2.1). Because the potential sources of contamination at the site are buried sewer lines, septic tanks, and leach field lines, there are no known potential sources of surface-soil contamination at the ADRA. No VOCs, SVOCs, or explosives were detected in the surface-soil samples.

2.2.5.3 Subsurface Soil

Twenty-six subsurface-soil samples were collected from the ADRA during the 1991 Group II RI. Samples were collected every 5 feet from ground surface to the water table in ADR-01-SB and ADR-02-SB and analyzed for California Title 22 metals, VOCs, and explosives. Samples were analyzed for SVOCs every 10 feet from ground surface to the borehole terminus. Ten test pits (Figure 2.1) were excavated and one soil sample was collected from below the leach field lines (approximately 4 to 5 feet bgs) in each excavation. All samples were analyzed for California Title 22 metals, VOCs, SVOCs, and explosives. No VOCs, SVOCs, or explosives were present in detectable concentrations in subsurface-soil samples collected from the soil borings and test pits. All metals present are interpreted to be naturally occurring (Table 2.2).

2.2.5.4 Groundwater

The groundwater below the ADRA was characterized using data obtained from three water-table monitoring wells installed during the 1991 Group II RI and four Hydropunch groundwater samples collected during the 1993 Group I and II Follow-Up RI.

Hydropunch Samples

Hydropunch samples were collected from the first 5 feet of the water table at four locations below the leach field at the ADRA during the 1993 Group I and II Follow-Up RI (Figure 2.1). The groundwater samples were analyzed for California Title 22 metals, VOCs, and explosives. One of the samples, ADR-02-HP, was also analyzed for SVOCs and nitrate plus nitrite. Low levels of VOCs were detected in two of the Hydropunch groundwater samples (Table 2.3). Low concentrations of VOCs may have been present in the wastewater that was discharged through the leach field, so low concentrations in the groundwater could be expected. These levels are below the respective California or federal MCLs for each compound. No explosives were detected in the Hydropunch samples (Table 2.3). All metals and nitrate plus nitrite present in the groundwater at detectable concentrations are interpreted to be naturally occurring.

Monitoring Well Samples

Three water-table monitoring wells were installed at the ADRA during the 1991 Group II RI. These wells have been sampled during six rounds of groundwater sampling. Two rounds of groundwater

sampling were conducted during the 1991 Group II RI, and the samples were analyzed for EPA priority pollutant metals, VOCs, SVOCs, explosives, and macroparameters. During the 1992 Group I Follow-Up RI, the wells were sampled for two rounds and analyzed for EPA priority pollutant metals, VOCs, and explosives. The last two rounds of sampling were conducted during the 1993 Group I and II Follow-Up RI, and the samples were analyzed for VOCs and explosives. In addition, groundwater samples were also analyzed for nitrates plus nitrites during the last round of sampling.

Four metals were detected above the maximum background concentrations observed at SIAD (Table 2.3). No metals were detected above the current California MCLs and all are considered to represent native conditions.

Low levels of toluene and trichloroethylene (TCE) have been detected sporadically in two of the wells at the ADRA (Table 2.3). The levels of toluene detected are below the federal MCL for toluene of 1,000 micrograms per liter ($\mu g/l$). There is no current California MCL for toluene. All detections of TCE were below the federal and California MCLs for TCE.

No SVOCs were detected in the three monitoring wells.

Low levels of explosives were detected sporadically in the three monitoring wells during the six groundwater sampling rounds (Table 2.3). No explosives were detected during the most recent round of sampling (January 1994).

Groundwater samples collected during the 1993 Group I and II Follow-Up RI second round of groundwater sampling were analyzed for nitrate plus nitrite as a general water quality parameter to help evaluate groundwater flow and aquifer conditions in the southern portion of the depot. Nitrate plus nitrite is not a suspected site contaminant at the ADRA. Nitrate and nitrite levels can be elevated as a result of the breakdown of explosives compounds. However, if the nitrate plus nitrite in the groundwater at the ADRA was present due to the breakdown of explosive compounds then explosive compounds would be present in comparable concentrations. Explosive compounds have not been detected at concentrations exceeding 5 $\mu g/l$, but the levels of nitrate plus nitrite detected in

groundwater at the ADRA range from 7,300 µg/l to 17,000 µg/l. The nitrate plus nitrite concentrations in the ADRA wells are similar to the levels detected in the designated background wells: BKG-01-MWA at 13,000 µg/l; BKG-02-MWA at 2,000 µg/l; and DSB-04-MWA at <10µg/l. No current MCLs are available for the sum of nitrate plus nitrite.

2.2.6 Summary of Site Risks

This section presents a summary of the baseline risk assessment conducted for the ADRA during the 1993 Group I and II Follow-Up RI (Montgomery Watson, 1994).

2.2.6.1 Compounds of Potential Concern

The process of selecting compounds of potential concern (COPCs) considers a number of factors, such as toxicity, physical and chemical properties of the compound, environmental persistence, medium-specific mobility, ability to bioaccumulate, potential routes of exposure, spatial extent of monitoring data, range and magnitude of concentrations detected, and frequency of detection. Compounds that were detected at least once in an environmental medium (soil and groundwater) were qualitatively screened to determine frequency of detection and toxicity (i.e., whether the compound is an essential nutrient, a carcinogen, or a noncarcinogen). Background concentrations have not been used in the selection of COPCs. The COPCs in surface soil at the ADRA are arsenic, barium, and vanadium.

The COPCs in subsurface soil at the ADRA are arsenic, barium, mercury, and vanadium. The COPCs in groundwater at the ADRA are TCE, antimony, arsenic, barium, calcium, lead, mercury, molybdenum, selenium, sodium, and 1,3,5-trinitrobenzene. Groundwater is not a current completed pathway at the site.

2.2.6.2 Contaminant Fate and Transport

Fate and transport properties were evaluated for chemicals identified as COPCs at the ADRA in the 1993 Group I and II Follow-Up RI Report (Montgomery Watson, 1994). The purpose of evaluating fate and transport properties of COPCs was to assess the potential for these COPCs to migrate to other media, or to human or ecological receptor locations. Chemical transport mechanisms considered for

this site include wind dispersion and surface-water runoff. Because the COPCs are nonvolatile metals, volatilization from soil to air is not expected.

Wind dispersion is a potentially important release mechanism due to the arid character of the site and erodible surface soil (USATHAMA, 1979). Surface-water runoff is expected to be a negligible release mechanism due to the low annual precipitation at SIAD (less than 6 inches on average) and high infiltration capacity of the surface soil.

Because metals tend to be persistent and relatively insoluble, these chemicals are expected to bind closely to particulate matter and bioavailability is expected to be limited (i.e., uptake in the primary organism may occur, but concentrations would not be expected to significantly biomagnify through the food web). Therefore, the fate and transport potential for metals at the site is of low significance.

2.2.6.3 Human Health Risks

The results of the human health risk assessment for the ADRA are summarized in Table 2.4. Potential noncancer health effects and cancer risk were evaluated separately.

Soil

The excess lifetime cancer risk (ELCR) and the hazard index (HI) for current baseworkers at the ADRA are 1.6×10^{-5} and 0.044, respectively (Table 2.4). The ELCR estimates are above the California benchmark of 1×10^{-6}. Cancer risks at the ADRA are primarily due to arsenic, with a much lower contribution to risk from chromium. Arsenic at the ADRA is present at naturally occurring levels in the surface soil. The cancer risk estimates are within the range (1×10^{-4} to 1×10^{-6}) provided in the NCP (1990) for the Superfund site remediation goals. The HIs are less than the benchmark of 1.

The ELCR and HI for construction workers exposed to surface soil at the ADRA are 3.2×10^{-6} and 0.19, respectively (Table 2.4). The risks are estimated for construction worker exposure to surface soil at the ADRA site via inhalation, ingestion, and dermal routes of exposure. The ELCR estimates are above the California benchmark of 1×10^{-6} for both sites. However, cancer risks to future construction workers at the site are due entirely to arsenic, which is present at naturally occurring levels in surface soil. The HI is less than the benchmark of 1.

Risks were also estimated for construction worker exposure to subsurface soil at the ADRA site via inhalation, ingestion, and dermal routes of exposure (Table 2.4). The ELCR and HI for subsurface soil exposure at the ADRA are 3×10^{-6} and 0.17, respectively. The ELCR estimate is above the California benchmark of 1×10^{-6} but represents the risks due to naturally occurring levels of arsenic in subsurface soil. The HI is less than the benchmark of 1. In addition, the cancer risk estimate is within the range (1×10^{-4} to 1×10^{-6}) provided in the NCP (1990) for the Superfund site remediation goals.

Risks for hypothetical future residents at the ADRA site also were estimated. Risks were estimated for adult and child residential exposure to surface soil via inhalation, ingestion, and dermal routes of exposure. The ELCR and HI for a hypothetical future adult resident exposure to surface soil are 3.6×10^{-5} and 0.086 at the ADRA, respectively (Table 2.4). The ELCR and HI for a hypothetical future child resident exposure to surface soil are 6.8×10^{-5} and 0.66 for the ADRA, respectively. The ELCR estimates are above the California benchmark of 1×10^{-6} for adult and child future residents for both sites. However, cancer risks to future adult residents are due entirely to arsenic, which is present at naturally occurring levels in surface soil. The HIs are less than the benchmark of 1. In addition, the cancer risk estimates are within the range (1×10^{-4} to 1×10^{-6}) provided in the NCP (1990) for the Superfund site remediation goals.

Groundwater

Four potable supply wells are used by SIAD. The nearest potable supply well is approximately 1 mile south (upgradient) of the ADRA and will not be affected by chemicals in groundwater at the ADRA. Therefore, groundwater is not a completed pathway for the site.

Risks were estimated for hypothetical future residential use of groundwater even though potential future use of the shallow groundwater is highly unlikely. Risks were estimated for adult and child residential exposure to groundwater soil via inhalation, ingestion, and dermal routes of exposure (Table 2.4). The ELCR and the HI for a hypothetical future adult resident exposure to groundwater are 7.5×10^{-4} and 3.4, respectively, for the ADRA. The ELCR and HI for a hypothetical future child resident exposure to groundwater are 4.4×10^{-4} and 8.0, respectively. The ELCR estimates are above

the California benchmark of 1×10^{-6} for the hypothetical adult and child resident at both sites. In addition, the HIs are all above the benchmark of 1. These exceedances represent the risks due to arsenic and antimony in groundwater. Although antimony was quantitatively evaluated in the baseline risk assessment, it is much more likely that the antimony detected in the groundwater is related to equipment contamination. Rinsate blanks from the field investigation indicate the presence of antimony, suggesting it is a common contaminant in the filters used in the groundwater sampling at the site. Therefore, the risks associated with antimony in groundwater at the ADRA are not considered to represent site-related risk estimates. In addition, evaluation of arsenic in groundwater and soil strongly suggest that this compound is present at levels representing native conditions at the ADRA site.

Total hypothetical future site risk was estimated as follows: the site risk calculated for the child resident (0 to 6 years) is added to the site risk calculated for the adult resident (6 to 24 years) in order to provide a 30-year residential exposure. Further, the total site risk sums all of the residential exposures considered in the risk assessment, which includes soil exposures by adult and child residents and groundwater exposure by adult and child residents. The combined risk across all pathways (groundwater and soil) for a total hypothetical future resident results in a total site ELCR of 1.3×10^{-3} and a HI of 12.

2.2.6.4 Environmental Risks

A qualitative environmental assessment was performed for the ADRA (Montgomery Watson, 1994). The purpose of this assessment was to evaluate the potential for adverse effects to ecological receptors as a result of possible exposure to chemicals originating from the ADRA.

Risk is a function of exposure and toxicity. While it is expected that on occasion the site may be utilized as a secondary hunting area by some avian species of special concern, the site is relatively small compared to expanded home ranges typical of desert biomes. Moreover, the quality of hunting is likely inferior to that of surrounding regions. Toxicologically, the bioaccumulation potential for the COPCs would be expected to be relatively small due to the ability of organisms to metabolize, excrete, or sequester these chemicals, posing no significant threat to wildlife. These circumstances

strongly suggest that ecological species of special concern are not adversely impacted by chemicals detected at the site.

2.2.7 Description of the No Action Alternative

Based on the results of the baseline risk assessment and environmental risk assessment conducted for the ADRA site, there are no adverse impacts to human health or the environment from site-related activities. The elevated risks appear to be from naturally occurring levels of arsenic in the soil and groundwater. Thus, the No Action alternative is supported by the baseline risk assessment discussed in Section 2.2.6 and the Administrative Record.

2.2.8 Explanation of Significant Changes

The Proposed Plan for Nine Sites at SIAD was released to the public for comment on February 7, 1996. The preferred alternative identified for the ADRA was No Action. Based on the absence of any new information or comments during the public comment period, no significant changes to the selected remedy for the ADRA outlined in the Proposed Plan for Nine Sites were necessary.

2.3 Responsiveness Summary

The public comment period for the Proposed Plan for Nine Sites at SIAD began on February 7, 1996, and extended through March 7, 1996. No written comments were received by the Army or regulatory agencies. The public meeting presenting the Proposed Plan was held on February 22, 1996. No oral comments were received regarding the ADRA at the public meeting.

Table 2.1: Metals Above Background in Surface Soil
Ammunition Demilitarization and Renovation Area

Compound	Concentrations in µg/kg (dry)									
	CRL*	CRL (JS11) (1990-1991)	CRL (JS16) (1992-1993)	Number of Samples Above Median Soil Type - 365	Number of Samples Above Maximum Soil Type - 365	Number of Samples Above Median All Soil Types	Number of Samples Above Maximum All Soil Types	Frequency of Detects	Minimum	Maximum
Arsenic	0.25	---	---	2/2	2/2	2/2	0/2	2/2	6.24	7.51
Antimony	---	3.80	7.14	0/2	0/2	0/2	0/2	0/2	<3.80	<3.80
Barium	---	29.6	5.20	1/2	1/2	1/2	0/2	2/2	92.6	390
Beryllium	---	1.86	0.500	0/2	0/2	0/2	0/2	0/2	<1.86	<1.86
Cadmium	---	3.05	0.700	0/2	0/2	0/2	0/2	0/2	<3.05	<3.05
Chromium	---	12.7	4.05	0/2	0/2	0/2	0/2	0/2	<12.7	<12.7
Cobalt	---	15.0	1.42	0/2	0/2	0/2	0/2	0/2	<15.0	<15.0
Copper	---	58.6	0.965	0/2	0/2	0/2	0/2	0/2	<58.6	<58.6
Lead	0.177	6.62	10.5	0/2	0/2	0/2	0/2	0/2	<6.62	<6.62
Mercury	0.05	---	---	0/2	0/2	0/2	0/2	0/2	<0.05	<0.05
Molybdenum	---	1.15	1.12	0/2	0/2	0/2	0/2	0/2	<1.15	<1.15
Nickel	---	12.6	1.71	0/2	0/2	0/2	0/2	0/2	<12.6	<12.6
Selenium	0.25	---	---	0/2	0/2	0/2	0/2	0/2	<0.25	<0.25
Silver	---	2.50	0.589	0/2	0/2	0/2	0/2	0/2	<2.50	<2.50
Thallium	---	31.3	6.623	0/2	0/2	0/2	0/2	0/2	<31.3	<31.3
Vanadium	---	13.0	3.39	2/2	0/2	0/2	0/2	2/2	22.2	36.1
Zinc	---	30.2	8.03	0/2	0/2	0/2	0/2	0/2	<30.2	<30.2

µg/kg Micrograms per kilogram

* Certified Reporting Limit (CRL) for analyses other than JS11 and JS16

Table 2.2: Metals Above Background in Subsurface Soil
Ammunition Demilitarization and Renovation Area

	Concentrations in µg/kg (dry)									
Compound	CRL*	CRL (JS11) (1990-1991)	CRL (JS16) (1992-1993)	Number of Samples Above Median USCS Soil Type for Individual Sample	Number of Samples Above Maximum USCS Soil Type for Individual Sample	Number of Samples Above Median for all USCS Soil Types	Number of Samples Above Maximum for All USCS Soil Types	Frequency of Detects	Minimum	Maximum
Arsenic	0.25	---	---	22/26	0/26	21/26	0/26	26/26	1.44	14.0
Antimony	---	3.80	7.14	0/26	0/26	0/26	0/26	0/26	<3.80	<3.80
Barium	---	29.6	5.20	13/26	1/26	10/26	0/26	21/26	<29.6	268
Beryllium	---	1.86	0.500	0/26	0/26	0/26	0/26	0/26	<1.86	<1.86
Cadmium	---	3.05	0.700	0/26	0/26	0/26	0/26	0/26	<3.05	<3.05
Chromium	---	12.7	4.05	0/26	0/26	0/26	0/26	0/26	<12.7	<12.7
Cobalt	---	15.0	1.42	0/26	0/26	0/26	0/26	0/26	<15.0	<15.0
Copper	---	58.6	0.965	0/26	0/26	0/26	0/26	0/26	<58.6	<58.6
Lead	0.177	6.62	10.5	0/26	0/26	0/26	0/26	0/26	<6.62	<6.62
Mercury	0.05	---	---	2/26	2/26	2/26	2/26	2/26	<0.05	0.131
Molybdenum	---	1.15	1.12	1/26	0/26	1/26	0/26	1/26	<1.15	2.18
Nickel	---	12.6	1.71	0/26	0/26	0/26	0/26	0/26	<12.6	<12.6
Selenium	0.25	---	---	0/26	0/26	0/26	0/26	0/26	<0.25	<0.25
Silver	---	2.50	0.589	0/26	0/26	0/26	0/26	0/26	<2.50	<2.50
Thallium	---	31.3	6.623	0/26	0/26	0/26	0/26	0/26	<31.3	<31.3
Vanadium	---	13.0	3.39	15/26	4/26	8/26	0/26	25/26	<13.0	80.0
Zinc	---	30.2	8.03	2/26	1/26	2/26	0/26	2/26	<30.2	76.8

µg/kg Micrograms per kilogram
USCS Unified Soil Classification System

* Certified Reporting Limit (CRL) for analyses other than JS11 and JS16

Table 2.3: Summary of Compounds Detected in Groundwater
Ammunition Demilitarization and Renovation Area

Analyte	State MCL	Federal MCL	MRL	Concentrations in µg/l Round 1	Round 2	Round 3	Round 4	Round 5	Round 6
ADR-01-MWA				**4/16/91**	**7/16/91**	**2/26/92**	**4/23/92**	**11/1/93**	**1/23/94**
Organic Compounds									
Toluene	150	1,000[b]	0.5	ND	ND	0.49	ND	ND	ND
TCE	5	5	0.5	ND	ND	ND	ND	0.95	0.49
Explosive Compounds									
1,3,5-Trinitrobenzene	NA	NA	0.63	3.65	2.94	ND	ND	ND	ND
1,3-Dinitrobenzene	NA	NA	0.61	ND	ND	ND	ND	1.98	ND
Metals[a]									
Copper	NA	1,000	8.09	ND	20.0	ND	8.26	NA	NA
Mercury	2	2	0.24	0.603	ND	ND	ND	NA	NA
Lead	50	NA[c]	1.26	ND	ND	2.17	ND	NA	NA
Nitrate plus nitrite	NA	NA	10	NA	NA	NA	NA	NA	16,000
ADR-02-MWA				**4/16/91**	**7/16/91**	**2/25/92**	**4/24/92**	**11/1/93**	**1/23/94**
Organic Compounds				ND	ND	ND	ND	ND	ND
Explosive Compounds									
1,3,5-Trinitrobenzene	NA	NA	0.63	1.03	0.81	ND	ND	ND	ND
Metals[a]									
Barium	1,000	2,000	5	45.7	43.8	46.5	47.5	NA	NA
Nitrate plus nitrite	NA	NA	10	NA	NA	NA	NA	NA	17,000
ADR-03-MWA				**4/16/93**	**7/16/93**	**2/25/92**	**4/24/92**	**11/1/93**	**1/25/94**
Organic Compounds									
TCE	5	5	0.5	0.829	ND	ND	ND	ND	0.71
Toluene	NA	1,000[b]	0.5	ND	ND	0.569	ND	ND	ND
Explosive Compounds									
1,3,5-Trinitrobenzene	NA	NA	0.63	0.818	ND	ND	ND	ND	ND
Metals[a]									
Barium	1,000	2,000	5	ND	29.9	31.5	ND	NA	NA
Copper	NA	1,000	8.09	ND	11.1	ND	8.53	NA	NA
Nitrate plus nitrite	NA	NA	10	NA	NA	NA	NA	NA	7,300
ADR-01-HP				-	-	-	-	-	**8/17/93**
Organic Compounds									
Xylenes	1,750	10,000[d]	0.84	NA	NA	NA	NA	NA	1.9
Explosive Compounds				NA	NA	NA	NA	NA	ND
Metals[a]									
Barium	1,000	2,000	5	NA	NA	NA	NA	NA	37.8

Table 2.3: Summary of Compounds Detected in Groundwater Ammunition Demilitarization and Renovation Area (continued)

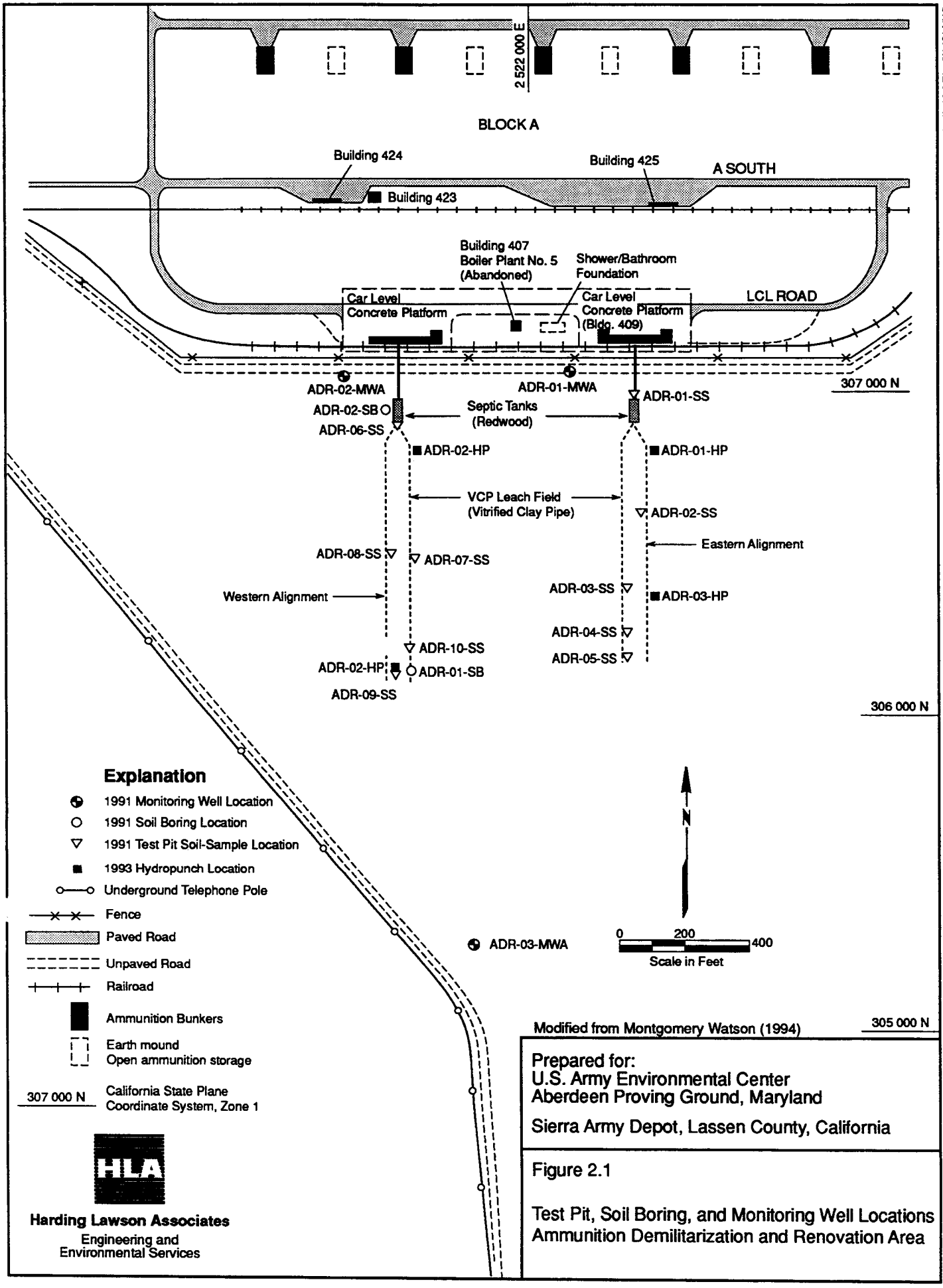
Analyte	State MCL	Federal MCL	MRL	Concentrations in µg/l Round 1	Round 2	Round 3	Round 4	Round 5	Round 6
ADR-02-HP				-	-	-	-	-	**8/17/93**
Organic Compounds									
Butylbenzyl phthalate	4	6	3.40	NA	NA	NA	NA	NA	3.5
Toluene	NA	1,000[b]	0.5	NA	NA	NA	NA	NA	17
TCE	5	5	0.5	NA	NA	NA	NA	NA	0.95
Explosive Compounds				NA	NA	NA	NA	NA	ND
Metals[a]									
Barium	1,000	2,000	5	NA	NA	NA	NA	NA	31
Copper	NA	1,000	8.09	NA	NA	NA	NA	NA	10.7
Nitrate plus nitrite	NA	NA	10	NA	NA	NA	NA	NA	14,000
ADR-03-HP				-	-	-	-	-	**8/17/93**
Organic Compounds				NA	NA	NA	NA	NA	ND
Explosive Compounds				NA	NA	NA	NA	NA	ND
Metals[a]									
Barium	1,000	2,000	5.00	NA	NA	NA	NA	NA	65.7
ADR-04-HP				-	-	-	-	-	**8/18/93**
Organic Compounds				NA	NA	NA	NA	NA	ND
Explosive Compounds				NA	NA	NA	NA	NA	ND
Metals[a]									
Barium	1,000	2,000	5.00	NA	NA	NA	NA	NA	31.5
Copper	NA	1,000	8.09	NA	NA	NA	NA	NA	9.11

MCL Maximum contaminant level
MRL Method reporting limit
NA Not analyzed/not available
ND Not detected
TCE Trichloroethylene
µg/l Micrograms per liter

a. Metals detected above the maximum background concentration for each analyte shown on Table 6-6.
b. Secondary federal MCL for toluene is 40 µg/l.
c. Federal action level for lead is 15 µg/l.
d. Secondary federal MCL for xylenes is 20 µg/l.

Table 2.4: Summary of Multipathway Exposures at the Ammunition Demilitarization and Renovation Area

Exposure Scenario/Exposure Pathway	Hazard Index	Excess Lifetime Cancer Risk
Current Baseworker		
Soil exposure	0.044	1.6E-05
Current and Future Construction Worker		
Surface-soil exposure	0.19	3.2E-06
Subsurface-soil exposure	0.17	3.0E-06
Current Casual Visitor		
Surface-soil exposure	0.011	2.0E-06
Hypothetical Future Adult Resident		
Soil exposure	0.086	3.6E-05
Groundwater exposure	3.4	7.5E-04
Hypothetical Future Child Resident		
Soil exposure	0.66	6.8E-05
Groundwater exposure	8.0	4.4E-04


SRA 1071.3 12/8/95 ECS
2 522 000 E
BLOCK A
Building 424
Building 425
A SOUTH
Building 423
Building 407
Boiler Plant No. 5
(Abandoned)
Shower/Bathroom
Foundation
Car Level
Concrete Platform
Car Level
Concrete Platform
(Bldg. 409)
LCL ROAD
307 000 N
ADR-02-MWA
ADR-01-MWA
ADR-02-SB
ADR-06-SS
Septic Tanks
(Redwood)
ADR-01-SS
ADR-02-HP
ADR-01-HP
VCP Leach Field
(Vitrified Clay Pipe)
ADR-02-SS
Eastern Alignment
ADR-08-SS
ADR-07-SS
Western Alignment
ADR-03-SS
ADR-03-HP
ADR-04-SS
ADR-10-SS
ADR-02-HP
ADR-01-SB
ADR-05-SS
ADR-09-SS
306 000 N
Explanation
1991 Monitoring Well Location
1991 Soil Boring Location
1991 Test Pit Soil-Sample Location
1993 Hydropunch Location
Underground Telephone Pole
Fence
Paved Road
Unpaved Road
Railroad
Ammunition Bunkers
Earth mound
Open ammunition storage
307 000 N
California State Plane
Coordinate System, Zone 1
ADR-03-MWA
N
0
200
400
Scale in Feet
Modified from Montgomery Watson (1994)
305 000 N
Prepared for:
U.S. Army Environmental Center
Aberdeen Proving Ground, Maryland
Sierra Army Depot, Lassen County, California
Figure 2.1
Test Pit, Soil Boring, and Monitoring Well Locations
Ammunition Demilitarization and Renovation Area
HLA
Harding Lawson Associates
Engineering and
Environmental Services

3.1.3 Description of the Selected Remedy

The selected remedy involves excavation and offsite asphalt incorporation of surface and subsurface soil contaminated with motor oil constituents. The total present-worth cost for this remedy is $106,000.

3.1.4 Statutory Determinations

The selected remedy for the Building 1003 Area satisfies the statutory requirements of CERCLA § 121 and § 120(a)(4). The following mandates are satisfied:

- The selected remedy is protective of human health and the environment.
- The selected remedy complies with federal and state requirements that are legally applicable or relevant and appropriate for the remedial action.
- The selected remedy is cost effective.
- The selected remedy utilizes permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable.
- The selected remedy satisfies the statutory preference for remedies that employ treatment that reduces toxicity, mobility, or volume as a principal element.

3.2 Decision Summary

This section provides the site-specific factors and analysis that were considered in the selection of the response action for the Building 1003 Area.

3.2.1 Site Description

A waste oil spill was discovered at the gas station (Building 1003) located along Susanville Road on January 27, 1988. Waste oil spilled at the gas station and was transported through a storm drain to a gently sloping drainage area north of Susanville Road. The spill, which was estimated to have occurred over a 20- to 24-month period, is estimated to be 900 gallons of waste oil. The spill was the result of a clogged oil/water separator that diverted waste oil from the underground storage tank to the storm drain (Benioff, et al., 1988).

3.0 BUILDING 1003 AREA

3.1 Declaration

This section provides the declaration portion of the ROD/RAP for the Building 1003 Area.

3.1.1 Location

The Building 1003 Area is located north of Susanville Road and a gas station (Building 1003) within the southern portion of SIAD (Figure 1.1). The site is located 1,600 feet east-southeast of Potable Supply Well (PSW) No. 5.

3.1.2 Assessment of the Site

A contamination assessment of the Building 1003 Area was conducted in the 1993 Group I and II Follow-Up RI Report (Montgomery Watson, 1994). The results of that assessment are summarized as follows:

- Overflow of an oil/water separator at Building 1003 caused a release of waste oil through an underground storm drain into an open field north of Susanville Road.
- Lead, zinc, and petroleum hydrocarbons are present in the upper 2 feet of soil within the area of the storm drain release.
- Petroleum hydrocarbons are present at detectable concentrations at depths greater than 2 feet bgs in a small area approximately 125 feet north of the storm drain outlet.
- Groundwater beneath the area of soil contamination does not appear to have been affected by the 1988 waste oil release.

Potentially unacceptable risks to human health from the detected concentrations of arsenic in groundwater, surface soil, and subsurface soil were identified in residential exposure scenarios during the baseline risk assessment (Montgomery Watson, 1994). However, the arsenic in the soil and groundwater at the Building 1003 Area is interpreted to represent native conditions. No adverse effects to ecological receptors from exposure to contaminants at the Building 1003 Area were identified in the baseline risk assessment.

indicated that the groundwater directly beneath the soil contamination does not appear to have received constituents from the 1988 waste oil release.

3.2.3 Highlights of Community Participation

One 30-day public comment period was held from February 7, 1996, to March 7, 1996. A public meeting was held at SIAD on February 22, 1996. Representatives of the Army, DTSC, and the Lahontan RWQCB were present at the meeting. Responses to site-specific questions raised by the public at this meeting are presented in Section 3.3 of this ROD/RAP.

The public participation requirements of CERCLA § 113(K)(2)(B)(i-v) and § 117, and § 25356.1 of the California Health and Safety Code were met in the remedy selection for this site. The response action presented for this site in this ROD/RAP was selected in accordance with CERCLA, the NCP, Chapter 6.8 of the California Health and Safety Code, and California Water Code. The basis for this decision is documented in the Administrative Record.

3.2.4 Scope and Role of Response Action

This ROD/RAP presents the final response action for the Building 1003 Area. The purpose of the response action at the Building 1003 Area is to remove soil contaminated with motor oil to protect human health and the environment. This will be the final response action for the Building 1003 Area.

3.2.5 Site Characteristics

The suspected source of waste oil, and metals associated with waste oil, in the soil at the Building 1003 Area is an oil/water separator that became clogged and overflowed, discharging water mixed with waste oil to a storm drain leading to the drainage outlet at the Building 1003 Area. The distribution and extent of chemicals present at the Building 1003 Area were assessed on the basis of data obtained from 35 surface-soil samples, 18 near-surface samples, 9 soil borings, 4 Hydropunch groundwater samples, and 1 water-table monitoring well.

The area of soil contamination consists of a broad open area north of a storm drain outfall. The storm drain collects surface flow from the area south of Susanville Road, including the gas station. A small drainage channel eroded into the sandy surface soil extends about 70 feet north from the storm drain outfall. Beyond a distance of about 70 feet north of the storm drain outlet, the drainage channel becomes indistinct and much of the stormwater flow probably dissipates and occurs as sheet flow across the ground surface prior to infiltration into the subsurface. Little or no drainage appears to leave the site; surface water appears to infiltrate within the area of preferential drainage shown in Figure 3.1.

3.2.2 Site History and Enforcement Activities

Investigations that have been conducted at the Building 1003 Area include:

- 1991 Group II Remedial Investigation, JMM
- 1992 Group I Follow-Up Remedial Investigation, Montgomery Watson
- 1993 Group I and II Follow-Up Remedial Investigation, Montgomery Watson

An oil/water separator at the gas station on Susanville Road overflowed in January 1988. The waste oil was transported through an underground storm drain and was released into a field north of Susanville Road. Previous investigations at this site had focused on the characterization of the waste oil in the surface and subsurface soil at the site.

One monitoring well was installed during the 1991 Group II RI approximately 25 feet north of the storm drain outlet. This monitoring well has been sampled six times and no total petroleum hydrocarbons (TPHs) have been detected.

The 1993 Group I and II Follow-Up Remedial Investigation focused on the presence and extent, if present, of TPH in the groundwater beneath the site and further characterization of waste oil in the soil. The Hydropunch groundwater samples collected during the 1993 Group I and II Follow-Up RI

Lead, zinc, chromium, mercury, and antimony were detected above background levels in surface and near-surface soil (Table 3.1; Figures 3.2 and 3.3). Lead, zinc, and possibly chromium in the surface soil are suspected to be above background levels as a result of the overflow of the oil/water separator in 1988. These metals are limited to the preferential drainage course and are typically associated with waste oil. Antimony and mercury are at levels that could be considered naturally occurring and are unlikely to be a result of the waste oil spill.

TRPH was detected in 23 of 35 surface-soil samples (Figure 3.4). The concentrations of TRPH in samples collected during the 1991 Group II RI range from <28.0 µg/g to 29,000 µg/g. The surface-soil samples collected during the 1993 Group I and II Follow-Up RI had lower detectable concentrations of TRPH in the surface soil. Concentrations ranged from <28 µg/g to 221 µg/g. This may be a result of biased sampling during the 1991 Group II RI; many samples were collected from locations of visible staining or in the preferential drainage course. Surface-soil sampling during the 1993 Group I and II Follow-Up RI took place within the preferential drainage course but was not as heavily biased toward soil with the highest concentrations of TRPH because of the general absence of visible staining. Actual decreases in the TRPH concentrations in surface soil may also have occurred from degradation of the TRPH constituents.

TPH-gas and TPH-diesel were not detected in the three surface-soil samples analyzed for these parameters. Hydrocarbon fingerprinting results show that the petroleum hydrocarbons in the soil at the Building 1003 Area have high carbon numbers that are indicative of motor oil constituents.

No SVOCs were detected in surface-soil samples collected at the Building 1003 Area during the 1991 Group II RI. Therefore, the surface-soil samples collected during the 1993 Group I and II Follow-Up RI were not analyzed for SVOCs.

3.2.5.1 Surface Soil

SIAD conducted an investigation at the Building 1003 Area when the waste oil spill was discovered in January 1988. As part of the 1988 investigation, waste oil samples were collected from the underground storage tank at the gas station and analyzed for VOCs, iron, manganese, and California Title 22 metals. Toluene and xylenes were detected above their respective detection limits. All metals detected in the waste oil were below the Title 22 Total Threshold Limit Concentration (TTLC) values (Benioff, et al., 1988).

During the 1988 investigation, 12 surface-soil samples were also collected at several locations and analyzed for total recoverable petroleum hydrocarbons (TRPH) (EPA Method 418.1), benzene, toluene, and xylenes. TRPH was detected in all 12 samples with concentrations ranging from 43 micrograms per gram (μg/g) to 23,000 μg/g. Benzene, toluene, and xylenes were not detected in any of the surface-soil samples (Benioff, et al., 1988).

During the 1991 Group II RI, 15 discrete surface-soil samples (BU1-01-SS through BU1-15-SS) were collected from the 0- to 6-inch interval. Four soil samples were also collected from the surface interval of 3 soil borings (BU1-01-SB through BU1-03-SB) and 1 monitoring well boring (BU1-01-MWA). The 19 surface-soil samples were analyzed for EPA priority pollutant metals, TRPH (EPA Method 418.1), SVOCs, and VOCs.

During the 1993 Group I and II Follow-Up RI, 10 discrete surface-soil samples (BU1-24-SS through BU1-34-SS) and the surface interval of 6 soil borings were collected and analyzed for lead and TRPH (EPA Method 418.1). Two of the sixteen 1993 Group I and II Follow-Up surface-soil samples were also analyzed for total petroleum hydrocarbons as gasoline (TPH-gas), TPH-diesel, Microtox bioassay, and heterotrophic plate count. One of the surface-soil samples also underwent fuel fingerprint characterization to determine the type of hydrocarbons present. The results of the 1991 and 1993 investigations conducted at the Building 1003 Area are discussed below.

Arsenic, antimony, barium, beryllium, lead, mercury, thallium, and zinc were detected above the maximum concentrations for soil type (Table 3.2). Metals detected in the subsurface above the maximum background concentrations for all soil types are shown in Figure 3.5.

Lead was detected in 22 of 135 subsurface-soil samples (Figure 3.5). Below a depth of 5 feet, the lead detected above the maximum background concentration is most likely related to variations in naturally occurring levels of lead and not the 1988 waste oil release. However, it is possible that in limited areas with higher TRPH concentrations, lead levels may be slightly elevated in the subsurface due to the 1988 waste oil release.

Arsenic, antimony, barium, beryllium, mercury, thallium, and zinc are believed to be naturally occurring and thus are not considered potential site contaminants.

VOCs at the Building 1003 Area are limited to isolated detections of trace VOC concentrations in the surface and subsurface soil.

SVOCs were not been detected in any of the subsurface-soil samples.

TRPH was detected in 23 of 135 subsurface-soil samples collected at the Building 1003 Area at concentrations ranging from <28.0 µg/g to 5,170 µg/g (Figure 3.6). TRPH was detected in 11 of 18 near-surface (2 feet bgs) soil samples. TRPH was only detected in 12 of 117 samples collected below 2 feet bgs.

TPH-gas and TPH-diesel were not detected in any of the five subsurface-soil samples analyzed for these parameters.

Low levels of VOCs (acetone; ethanol; 1,1,2-trichloro-1,2,2-trifluoroethane;and toluene) were detected in 2 of the 19 surface-soil samples collecting during the 1991 Group II RI. Ethanol and 1,1,2-trichloro-1,2,2-trifluoroethane were identified as tentatively identified compounds (TICs). Based on these trace concentrations, no further VOC analysis of surface-soil samples was performed during the 1993 Group I and II Follow-Up RI.

Results of heterotrophic plate count (HPC) and Microtox analyses showed that the motor oil constituents in surface soil are amenable to biodegradation.

3.2.5.2 Subsurface Soil

Eighteen near-surface (2 feet bgs) soil samples were collected and nine soil borings were drilled and sampled at the Building 1003 Area to characterize subsurface soil. During the 1991 Group II RI, eight near-surface soil samples (BU1-16-SS through BU1-23-SS) were collected. These samples were collected in locations where TRPH was detected in surface-soil samples. The samples were analyzed for EPA priority pollutant metals, VOCs, SVOCs, and TRPH. Three soil borings were drilled and sampled every 5 feet from ground surface to the water table (approximately 105 feet bgs) and analyzed for EPA priority pollutant metals, VOCs, and TRPH. Every other sample was analyzed for SVOCs. Ten soil samples were collected from 2 feet bgs at all 1993 Group I and II Follow-Up surface-soil sample locations and analyzed for lead and TRPH. Two of the ten near-surface soil samples were also analyzed for TPH-gas, TPH-diesel, oil and grease, Microtox, and HPC. Six soil borings were drilled and sampled to 30 feet bgs during the 1993 Group I and II Follow-Up RI. The samples were analyzed for lead and TRPH. Four samples were also analyzed for TPH-gas, TPH-diesel, oil and grease, Microtox, and HPC. All TRPH analyses were performed using EPA Method 418.1.

TPH-gas, TPH-diesel, or oil and grease were not detected in any of the Hydropunch groundwater samples.

Monitoring Well Samples

A total of six groundwater samples have been collected and analyzed from BU1-01-MWA since it was installed. Two sampling rounds were conducted during the 1991 Group II RI and were analyzed for EPA priority pollutant metals, TRPH, VOCs, SVOCs, and macroparameters (sulfate, total dissolved solids, chloride, sodium, calcium, alkalinity, and total organic carbon). Two sampling rounds were conducted during the 1992 Group I Follow-Up RI and samples were analyzed for EPA priority pollutant metals, TRPH, VOCs, and SVOCs. Two sampling rounds were conducted during the 1993 Group I and II Follow-Up RI and the samples were analyzed for lead, VOCs, SVOCs, TPH-gas, TPH-diesel, and oil and grease. One sample was also analyzed for nitrates plus nitrites during the second round of groundwater sampling in 1993. The results of all groundwater sampling are summarized in Table 3.3.

Barium, copper, lead, selenium, and silver were detected in BU1-01-MWA above the maximum concentrations detected in background wells (Tables 3.3 and 3.4). Although barium was detected above maximum background levels, it is below the current California MCL of 1,000 μg/l. Copper, lead, and silver were detected during the first round of groundwater sampling but were not detected during subsequent rounds of groundwater sampling. Selenium was detected in the first four rounds of sampling. However, selenium was not detected in soil at the Building 1003 Area and is not expected to be a potential site contaminant. Therefore, selenium found in groundwater at this site is interpreted to represent natural conditions.

TRPH, TPH-gas, TPH-diesel, or oil and grease were not detected in any of the groundwater samples collected from BU1-01-MWA.

Results of HPC and Microtox analyses showed that the subsurface-soil contaminants are amenable to biodegradation.

3.2.5.3 Groundwater

The groundwater below the Building 1003 Area was evaluated using six rounds of groundwater samples from one water-table monitoring well installed during the 1991 Group II RI (BU1-01-MWA) and four groundwater samples collected using a Hydropunch groundwater sampling device during the 1993 Group I and II Follow-Up RI.

Hydropunch Samples

Four Hydropunch groundwater samples were collected from the first 5 feet of the water table directly below the area of known soil contamination at the Building 1003 Area (Figure 3.1). These samples were analyzed for lead, VOCs, TPH-gas, TPH-diesel, and oil and grease. BU1-01-HP was located near Soil Boring BU1-01-SB in which TRPH was detected intermittently from ground surface to the water table (approximately 105 feet bgs). The other three Hydropunch samples were located radially around BU1-01-HP, because the groundwater gradient is not known at this site (Figure 3.1). The results of the groundwater sampling conducted at the Building 1003 Area are summarized in Table 3.3.

Lead was not detected in any of the Hydropunch groundwater samples. The Hydropunch groundwater samples were not analyzed for other metals.

Methyl ethyl ketone (MEK) was detected in one of the Hydropunch groundwater samples but was not detected in any of the other groundwater samples or in the soil samples collected at the site. The source of the MEK is unknown but it is not likely to be a product of the waste oil spill or representative of the groundwater beneath the site. No other VOCs were detected in any of the Hydropunch groundwater samples.

3.2.6.1 Compounds of Potential Concern

Petroleum hydrocarbons, lead, and zinc in surface and subsurface soil were identified as the COPCs in the 1993 Group I and II Follow-Up RI Report (Montgomery Watson, 1994).

3.2.6.2 Contaminant Fate and Transport

The fate and transport of chemicals in the environment is a function of numerous environmental factors. This section describes processes expected to control fate and transport of chemicals detected at the Building 1003 Area, and the primary chemical and physical properties impacting those processes.

Petroleum hydrocarbons, lead, and zinc in soil have been identified as the chemicals associated with the waste oil spill at the Building 1003 Area. Potential routes of migration of these chemicals include volatilization or dust emissions from surface soil, leaching from the soil to shallow ground-water, and lateral migration via surface-water runoff.

Soil at SIAD are best characterized as distal alluvial fan, alluvium, and lacustrine sediments. The organic carbon content of these soil ranges from low to high. Therefore, sorption of organic constituents and certain inorganic constituents (e.g., metallic mercury) can be expected to occur within zones in the unsaturated soil and aquifer. The sorption of most inorganic constituents is not affected as much by organic carbon content as are organic constituents; however, clays do effectively sorb many inorganic species. Clay-sized sediments are a small percentage of the soil at the Building 1003 Area.

Petroleum hydrocarbons representative of motor oil constituents were detected in surface and subsurface soil at the Building 1003 Area. The potential for migration and biodegradation of motor oil constituents is lower than for lighter petroleum hydrocarbons such as gasoline and diesel fuel constituents. Generally, the greater the number of carbons and the greater the molecular weight of

Low levels of methylene chloride and TCE were detected in the second and sixth rounds of groundwater sampling conducted at BU1-01-MWA. Methylene chloride is a common laboratory contaminant and was not detected in subsequent rounds of sampling. TCE was detected at a level below the current California MCL of 5 $\mu g/l$.

Bis(2-ethylhexylphthalate) was detected in BU1-01-MWA during the July 1991 sampling round; this compound is a common laboratory contaminant. No other SVOCs were detected at BU1-01-MWA in any of the groundwater sampling rounds.

Groundwater samples collected during the 1993 Group I and II Follow-Up RI second round of groundwater sampling were analyzed for nitrate plus nitrite as a general water quality parameter to help evaluate groundwater flow and aquifer conditions in the southern portion of the depot. Nitrates and nitrites have not been associated with waste oil and are not suspected to be part of the waste oil release at the Building 1003 Area. There is no reason to suspect an additional nitrate/nitrite source at the Building 1003 Area, so it is unlikely that the nitrate plus nitrite in the groundwater is related to SIAD activities.

The concentration of nitrate plus nitrite in BU1-01-MWA is greater than the concentrations detected in the designated background wells. However, the concentration is comparable to the levels detected in other wells located in the southern portion of the depot. The nitrate plus nitrite data are variable across the southern portion of the depot and appear to represent natural diversity in the water quality of the depot.

3.2.6 Summary of Site Risks

This section presents a summary of the baseline risk assessment conducted for the Building 1003 Area during the 1993 Group I and II Follow-Up RI (Montgomery Watson, 1994).

3.2.6.3 Human Health Risks

The results of the human health risk assessment conducted for the Building 1003 Area are summarized in Table 3.5.

Soil

The ELCR and the HI for the current baseworker scenario are 1.6×10^{-5} and 0.035, respectively. The ELCR estimate is above the California benchmark of 1×10^{-6}. Cancer risks for the current baseworker scenario are primarily due to naturally occurring levels of arsenic in surface soil, with a much lower contribution to risk from chromium. As discussed in the 1993 Group I and II Follow-up RI report (Montgomery Watson, 1994), the distribution of arsenic in soil at the Building 1003 Area is comparable to the distribution of arsenic in background soil. The cancer risk estimate is within the range (1×10^{-4} to 1×10^{-6}) provided in the NCP (1990) for Superfund site remediation goals. The hazard index is less than the benchmark of 1.

The ELCR and HI for a construction worker exposed to surface soil at the Building 1003 Area are 3.3×10^{-6} and 0.14, respectively. The ELCR and HI for a construction worker exposed to subsurface soil at the site are 1.2×10^{-5} and 0.65, respectively. Both ELCR estimates are above the California benchmark of 1×10^{-6}. However, the ELCR estimates are due primarily to naturally occurring levels of arsenic in soil at the site. In addition, the cancer risk estimates are within the range (1×10^{-4} to 1×10^{-6}) provided in the NCP (1990) for Superfund site remediation goals. Both HI estimates are less than the benchmark of 1.

The ELCR and HI for a current casual visitor are 2.0×10^{-6} and 0.11, respectively. The ELCR is within EPA benchmarks and slightly above the California benchmark of 1×10^{-6}. The HI is below the California and EPA benchmarks.

the compound, the more stable it will be in the environment. Petroleum hydrocarbons in the midcarbon range (C_6 to C_{30}) are considered moderately degradable. Motor oil constituents are usually in the C_{15} to C_{50} range.

Lead is generally immobile in soil at normal pH ranges and, therefore, is resistant to leaching. Lead sorbs strongly to soil, especially in the presence of iron, manganese, and aluminum oxides. Natural compounds of lead have low solubilities in water; therefore, the ratio of lead in suspended solids to dissolved lead is high. Lead will not volatilize from shallow soil; however, it may adsorb to airborne particulate matter. Lead is resistant to biodegradation but may bioaccumulate in plant and animal species.

Zinc is moderately mobile in soil under normal redox and pH conditions with mobility increasing with decreasing pH. Zinc is readily adsorbed by clays, carbonates, or hydrous oxides but will desorb if high concentrations of other metals are present. This metal will form complexes with inorganic and organic ligands. Some complexes have relatively high solubilities and will be mobile. Zinc is not volatile but may adsorb to airborne particulate matter. Zinc is resistant to biodegradation but will readily be taken up by most plant species and will bioconcentrate.

In summary, petroleum hydrocarbons and metals detected in the vadose zone at the Building 1003 Area are not expected to migrate to groundwater. This is primarily because the groundwater is relatively deep (approximately 105 feet bgs), the driving force is minimal (i.e., limited precipitation and only intermittent storm-water runoff), and petroleum hydrocarbons, lead, and zinc tend to sorb to soil. However, the intermittent storm-water runoff could cause some lateral migration of petroleum hydrocarbons and metals in surface soil.

3.2.6.4 Environmental Risks

The metals concentrations in surface and subsurface soil at the Building 1003 Area are not expected to significantly affect vegetation or wildlife. Adverse effects are expected to be low due to the relative infrequency with which chemicals were detected, low concentrations, and the small areal extent of the site. It should be noted that the Building 1003 Area site comprises less than 0.05 percent of the total acreage of the Main Depot at SIAD.

Petroleum hydrocarbons at the Building 1003 Area are in moderate to high concentrations, with moderate persistence in surface soil. However, their relatively low bioaccumulation potential indicates that there is less opportunity for these compounds to have a cumulative effect on wildlife, including threatened raptors, which have been found near the site. The major possibility for exposure is through ingestion of small mammals, a secondary dietary choice. Thus, the petroleum hydrocarbons are not considered to be a significant risk to environmental receptors, but localized removal may need to be considered for conservative protection.

Vegetation in this desert environment is sparse under natural conditions, but prior site usage does appear to have resulted in some restriction of growth and, ultimately, habitat. However, the diminished quality of these areas as habitat for wildlife is related to physical disturbances associated with site development and usage rather than chemical exposure.

3.2.7 Description of Alternatives

Six alternatives were developed for the Building 1003 Area in the Focused Feasibility Study prepared for this site (Montgomery Watson, 1996). The remedial alternatives are:

- Alternative 1 - No Action
- Alternative 2 - In Situ Bioremediation
- Alternative 3 - Excavation, Onsite Bioremediation, and Onsite Disposal
- Alternative 4 - Excavation and On-Base Reuse in Road Construction

The ELCR and HI for a hypothetical future adult resident exposure to surface soil are 3.6×10^{-5} and 0.067, respectively. The ELCR and HI for a hypothetical future child resident exposure to surface soil are 6.8×10^{-5} and 0.5, respectively. The ELCR estimates for adult and child future residents are above the California benchmark of 1×10^{-6}. However, the ELCR estimates are due primarily to naturally occurring arsenic levels in surface soil. In addition, the cancer risk estimates are within the range (1×10^{-4} to 1×10^{-6}) provided in the NCP (1990) for the Superfund site remediation goals. The hazard indices are less than the benchmark of 1.

Groundwater

Risks were estimated for adult and child future residential exposure to groundwater via inhalation, ingestion, and dermal routes of exposure. The ELCR and HI for a hypothetical future adult resident exposed to groundwater are 2.3×10^{-3} and 4.3, respectively. The ELCR and HI for a hypothetical future child resident exposed to groundwater are 1.3×10^{-3} and 10, respectively. The ELCR estimates are above the California benchmark of 1×10^{-6}, and the hazard indices are both above the benchmark of 1. These ELCR and HI estimates are primarily due to naturally occurring levels of arsenic in groundwater at the Building 1003 Area.

Total Site Risks

Total hypothetical future site risk for residential use was estimated by assuming that a future child resident could live on the site (a 6-year period), grow up, and continue to live there as an adult for a total residency period of 30 years. This total site risk is obtained by summing all of the residential exposures considered in the human health assessment: soil exposures by adult (24-year period) and child residents and groundwater ingestion by adult and child residents. The combined risk across all pathways (groundwater and soil) for a total hypothetical future resident results in a total site ELCR of 3.7×10^{-3}, and a hazard index of 15.

3.2.7.4 Alternative 4 - Excavation and On-Base Reuse

This alternative involves excavating soil that has concentrations of TPH above 1,000 μg/g, and transporting it to another location at SIAD where it would be used in road construction. The excavated soil at the site would be replaced with clean fill. The time necessary for implementation of this alternative is expected to be less than 3 months. The total present-worth cost for this alternative is $90,000.

3.2.7.5 Alternative 5 - Excavation and Offsite Recycling

This alternative involves excavating soil that has concentrations of TPH above 1,000 μg/g and transporting it to an offsite facility for recycling. The excavated soil at the site would be replaced with clean fill. The nearest recycling facility to SIAD is in Reno, Nevada. It should be noted, however, that the actual facility used for offsite recycling will be selected during the remedial design phase. The time necessary for implementation of this alternative is expected to be less than 3 months. The total present-worth cost for this alternative is $116,000.

3.2.7.6 Alternative 6 - Excavation and Offsite Asphalt Incorporation

This alternative involves excavating soil with concentrations of TPH above 1,000 μg/g and transporting it to an offsite asphalt batch plant for incorporation into asphalt. The excavated soil at the site would be replaced with clean fill. The nearest asphalt batch plant to SIAD is in Doyle, California. It should be noted, however, that the actual facility used for asphalt incorporation will be selected during the remedial design phase. The time necessary for implementation of this alternative is expected to be less than 3 months. The total present-worth cost for this alternative is $106,000.

3.2.8 Summary of Comparative Analysis of Alternatives

The remedial alternatives described in Section 3.2.7 have been assessed in accordance with the Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA (EPA, 1988b). That guidance and the NCP provide for analysis of nine criteria when evaluating remedial alternatives. The criteria are as follows:

- Alternative 5 - Excavation and Offsite Recycling
- Alternative 6 - Excavation and Offsite Asphalt Incorporation

3.2.7.1 Alternative 1 - No Action

The no-action alternative serves as a baseline for comparison with other remedial alternatives. No remedial actions would be performed at the Building 1003 Area to eliminate future potential exposure pathways, and thus any risks to human health and the environment would not be reduced. Because contaminants would remain onsite, the site would be reviewed every 5 years, as required under CERCLA. The total present-worth cost for this alternative is $60,000.

3.2.7.2 Alternative 2 - In Situ Bioremediation

This alternative consists of treating surface soil with TPH concentrations greater than 1,000 μg/g using in situ bioremediation. Surface soil would be regularly tilled and wetted with a water-nutrient solution to enhance the natural biodegradation of the petroleum hydrocarbons. To minimize disturbing the natural habitat of the site, tilling could be performed in a manner such that desert scrub vegetation is not destroyed. Storm water from the storm drain outfalls would be diverted during bioremediation treatment to prevent further lateral migration of soil contaminants. In situ bioremediation treatment would treat only the first 6 to 12 inches of soil. Therefore, contaminated soil deeper than 12 inches and with TPH levels greater than 1,000 μg/g (approximately 120 cy), would be excavated and transported to an offsite facility for incorporation into asphalt. This alternative is expected to take 1 year to achieve the TPH remediation level of 1,000 μg/g in surface soil. The total present-worth cost for this alternative is $151,000.

3.2.7.3 Alternative 3 - Excavation, Onsite Bioremediation, and Onsite Disposal

This alternative is similar to Alternative 2 except that all soil with TPH concentrations greater than 1,000 μg/g would be excavated and then treated aboveground using bioremediation. Following treatment, the soil would be backfilled at the site. The total present-worth cost for this alternative is $224,000.

- Compliance with Applicable or Relevant and Appropriate Requirements
  - Compliance with Chemical-specific ARARs
  - Compliance with Action-specific ARARs
  - Compliance with Location-specific ARARs
  - Compliance with other criteria, advisories, and guidance
- Long-term Effectiveness and Permanence
  - Magnitude of residual risk
  - Adequacy and reliability of controls
- Reduction of Toxicity, Mobility, and Volume Through Treatment
  - Treatment process used and materials treated
  - Amount of hazardous materials destroyed or treated
  - Degree of expected reductions in toxicity, mobility, and volume
  - Degree to which treatment is irreversible
  - Type and quantity of residuals remaining after treatment
- Short-term Effectiveness
  - Protection of community during remedial actions
  - Protection of workers during remedial actions
  - Environmental impacts
  - Time until remedial action objectives (RAOs) are achieved
- Implementability
  - Ability to construct and operate the technology
  - Reliability of the technology
  - Ease of undertaking additional remedial actions, if necessary
  - Ability to monitor effectiveness of remedy
  - Coordination with other agencies
  - Availability of offsite treatment, storage, and disposal services and capacity

- Threshold Criteria
  - Overall protection of human health and the environment
  - Compliance with ARARs
- Primary Balancing Criteria
  - Long-term effectiveness
  - Reduction of toxicity, mobility, and volume
  - Short-term effectiveness
  - Implementability
  - Cost
- Modifying Criteria
  - State acceptance
  - Community acceptance

Threshold criteria are requirements that each alternative must satisfy to be eligible for selection as the preferred alternative. Primary balancing criteria are used to weigh trade-offs among alternatives. Modifying criteria may be used to alter aspects of the preferred remedial alternative when preparing the Proposed Plan.

In the Focused Feasibility Study prepared for the Building 1003 Area (Montgomery Watson, 1996), the remedial alternatives were evaluated in terms of threshold and primary balancing criteria. Final evaluation of modifying criteria (state and community acceptance) was conducted after completion of the comment period on the Draft Final Feasibility Study (FS).

A brief description of each of the nine criteria is presented below.

- Overall Protection of Human Health and the Environment
  - How alternative provides human health and environmental protection

The State of California has previously recommended TPH remediation levels between 100 μg/g and 1,000 μg/g for other sites with petroleum hydrocarbon contamination. The Army proposes to remediate soil with TPH concentrations greater than 1,000 μg/g at the Building 1003 Area; this remediation level corresponds to an approximate soil volume of 170 cubic yards (cy). The 1,000 μg/g remediation level is proposed instead of the 100 μg/g level because motor oil constituents have relatively low mobility and toxicity. In addition, the lower remediation level would require treatment of approximately five times more soil (790 cy) but only an additional 20 percent of TPH mass in the soil would be treated.

Implementation of the no-action alternative (Alternative 1) would not reduce contaminant concentrations. Therefore, the potential for future exposure and lateral migration of soil contaminants remains. However, petroleum hydrocarbon concentrations in surface soil may decrease with time due to natural biodegradation. Alternative 2 (In Situ Bioremediation) would reduce TPH concentrations to below 1,000 μg/g in surface soil, thereby significantly reducing the potential for future exposure and lateral migration of soil contaminants. In addition, Alternative 2 would permanently remove contaminated subsurface soil from the site; this soil would be transported to a nearby asphalt batch plant for incorporation into asphalt. Alternatives 3 (Ex Situ Bioremediation), 4 (On-Base Reuse in Road Construction), 5 (Offsite Recycling), and 6 (Offsite Asphalt Incorporation) are expected to provide significant overall protection to human health and the environment by permanently removing contaminated soil from the site.

Because the contaminated soil at the Building 1003 Area currently poses no risks to ecological receptors, all the alternatives are considered to provide protection to the environment. Additionally, soil contamination at the site currently does not pose a threat to groundwater; therefore, all the alternatives are considered protective of groundwater quality. The 1,000 μg/g soil remediation level is considered protective of groundwater quality due to site conditions. The groundwater is relatively deep (approximately 105 feet bgs). Fine-grained layers, which act to retard the downward movement

- Availability of necessary equipment and specialists
- Availability of prospective technologies

• Cost

- Capital costs
- Operating and maintenance costs
- Present-worth cost

3.2.8.1 Overall Protection of Human Health and the Environment

The human health assessment conducted for the Building 1003 Area identified potential risks to future receptors based on soil and groundwater exposure (Montgomery Watson, 1994). However, these risks are due primarily to naturally occurring levels of arsenic in both media. Although zinc and lead were detected in soil at levels indicating that these metals are related to the waste oil discharge, these metals do not pose human health risks. Environmental assessment results indicate that the metals detected at the site also do not pose risks to ecological receptors. Therefore, metals are not considered constituents of concern for remedial action at the Building 1003 Area.

Risks based on exposure to petroleum hydrocarbons in soil at the Building 1003 Area were not quantitatively evaluated in the baseline risk assessment. From a qualitative standpoint, the petroleum hydrocarbons in motor oil are considered to have low toxicity to both human and ecological receptors. Despite the relatively low toxicity of motor oil constituents, the Army considers remediation of petroleum hydrocarbons in soil at the Building 1003 Area beneficial to the overall protection of human health and the environment at SIAD.

As discussed in Section 3.2.6.2, petroleum hydrocarbons and metals in the vadose zone are not expected to migrate vertically to groundwater. However, intermittent storm-water runoff at the site could cause some lateral migration of petroleum hydrocarbons that would increase the areal extent of surface-soil contamination.

found in, or discharged to, the ambient environment. If a chemical has more than one ARAR, the most stringent value will be complied with.

- Location-specific ARARs are restrictions placed on the concentration of a chemical or the activities to be conducted solely because they are in a specific location. Examples of special locations possibly requiring location-specific restrictions include floodplains, wetlands, historic places, and sensitive ecosystems or habitats.

- Action-specific ARARs are usually technology- or activity-based restrictions or requirements for remedial actions. These ARARs do not determine the remedial alternative to be applied at a site; rather, they indicate how a selected alternative will be implemented. The potential action-specific ARARs will vary depending on the remedial alternatives selected for the sites.

Where no standards exist for a given chemical or situation, nonpromulgated advisories and guidance issued by the state or federal government programs may represent "to be considered" (TBC) criteria or guidelines in the Remedial Investigation/Feasibility Study (RI/FS) process. Although TBC requirements are not legally binding, they may be evaluated along with ARARs as part of the risk assessment to establish protective target cleanup levels.

The following sections discuss the ARARs that were considered for the Building 1003 Area. A listing of federal and state laws that are ARARs for the Building 1003 Area is provided in Tables 3.6 and 3.7.

Chemical-specific ARARs

The Army has not identified any state or federal chemical-specific ARARs for any of the constituents detected in soil at the Building 1003 Area.

Location-specific ARARs

The Army has not identified any state or federal location-specific ARARs for the Building 1003 Area.

Action-specific ARARs

Chapter 15 of Title 23 Code of California Regulation (CCR) Division 3 ("Chapter 15") contains regulations governing discharges of waste to land where water quality could be adversely impacted. Chapter 15 regulations govern the discharge of waste to land for treatment, storage, and disposal and

of chemicals in the soil, are present in the shallow subsurface beneath the site. Additionally, the site receives little precipitation and has relatively high rates of evaporation, which further inhibits the transport of chemicals downward through the soil column.

3.2.8.2 Compliance with Applicable or Relevant and Appropriate Requirements

SIAD is not on the National Priorities List (NPL). Pursuant to CERCLA § 120(a)(4), remedial actions at non-NPL sites must comply with all state laws regarding removal or remedial actions. Further, the Army, as the lead agency, must select a remedial action that complies with CERCLA § 121(d)(1). Pursuant to CERCLA § 121(d)(1), remedial actions must attain a degree of cleanup that assures protection of human health and the environment. Additionally, remedial actions that leave hazardous substances, pollutants, or contaminants onsite must meet standards, requirements, limitations, or criteria that are applicable or relevant and appropriate requirements (ARARs). To the extent consistent with CERCLA and the NCP, the Army is not required to obtain federal, state, or local permits for those portions of the remedial actions conducted entirely onsite, but need only comply with the substantive, not procedural, provisions which would have been included in any such permit.

CERCLA § 121 states that, at the completion of a remedial action, a level or standard of control required by an ARAR will be attained for wastes that remain on site. In addition, the NCP, 40 CFR 300.435(b)(2), requires compliance with ARARs during the course of the remedial design/remedial action.

ARARs are identified on a site-specific basis from information about specific chemicals at the site, specific actions that are being considered as remedies, and specific features of the site location. There are three types of ARARs:

- Chemical-specific ARARs are health- or risk-based numerical values or methodologies that, when applied to site-specific conditions, result in the establishment of numerical values. These values establish the acceptable amount or concentration of a chemical that may be

To Be Considered Criteria

DTSC has indicated that a soil remediation level of 1,000 µg/g is appropriate for the Building 1003 Area. This remediation level is not promulgated; therefore, it is not an ARAR but a TBC.

Compliance with ARARs

Alternative 1 would not actively reduce motor oil constituent concentrations in soil to below the 1,000 µg/g remediation level for TPH. Because the 1,000 µg/g remediation level for TPH has been determined by the State of California to be protective of groundwater at this site, the Army has agreed to remediate TPH soil concentrations to this level. The Army and State of California have agreed to disagree on the applicability or relevance and appropriateness of Chapter 15 to this site but have agreed that the site remediation of TPH contaminated soil to a level below 1,000 µg/g will eliminate any potential threat to groundwater at this site. Alternative 2 would use in situ bioremediation to reduce TPH concentrations in surface soil to below 1,000 µg/g; subsurface soil with TPH levels above 1,000 µg/g would be excavated and incorporated into asphalt at an offsite facility. Alternatives 3 through 6 would involve removing all soil with TPH levels above 1,000 µg/g from the site.

3.2.8.3 Long-term Effectiveness and Permanence

Alternative 1 (No Action) would not provide long-term effectiveness and permanence because motor oil constituents would remain in soil. However, petroleum hydrocarbon concentrations in surface soil may decrease with time due to natural biodegradation. Alternatives 2 through 6 would provide long-term effectiveness and permanence by removing motor oil-contaminated soil from the site.

3.2.8.4 Reduction of Toxicity, Mobility, and Volume Through Treatment

Alternative 1 would not reduce the toxicity, mobility, or volume of contaminants through treatment because this alternative does not involve active treatment. Alternative 2 would accelerate the natural biodegradation process in surface soil thereby actively reducing the toxicity, mobility, and volume of motor oil constituents in surface soil. Asphalt incorporation of the subsurface soil as part of

establish siting, containment, monitoring, and closure standards. Activities included in this program are the issuance of waste discharge requirements (WDRs) by the Regional Water Quality Control Board for the discharge of hazardous, designated, and nonhazardous solid wastes to land and the oversight of corrective actions at leaking waste management units. Cleanup activities involving the discharge of waste to land or the closure of leaking waste management units at a CERCLA site would also be subject to the substantive requirements of Chapter 15. As discussed in Section 3.2.6.2, petroleum hydrocarbons and metals in the vadose zone at the Building 1003 Area are not expected to migrate to groundwater. Therefore, the remedial provisions of Chapter 15 have not been triggered.

Disposal of contaminated soil from Building 1003 Area could trigger California Hazardous Waste Management (HWM) land disposal restrictions due to elevated levels of lead in the soil exceeding the CCR Title 22 soluble threshold limit concentration (STLC) for lead. (However, as discussed in the Focused Feasibility Study [Montgomery Watson, 1996], waste extraction test [WET] results for several soil samples from the site indicate that is unlikely that soluble lead concentrations will exceed the lead STLC.) If land disposal restrictions are triggered, excavated soil would need to meet treatment standards and California HWM disposal regulations.

Disposal of contaminated soil from the Building 1003 Area could also trigger federal Department of Transportation (DOT) material shipment regulations. DOT regulations are applicable to the shipment of media containing waste oil and other hazardous materials. DOT regulations are found at 40 CFR 100-180.

Additional action-specific ARARs for all of the alternatives include state hazardous waste management, and state and federal occupational health and safety regulations (Tables 3.6 and 3.7).

- Alternative 1 - No Action ($60,000)
- Alternative 4 - Excavation and On-Base Reuse ($90,000)
- Alternative 6 - Excavation and Offsite Asphalt Incorporation ($106,000)
- Alternative 5 - Excavation and Offsite Recycling ($116,000)
- Alternative 2 - In Situ Bioremediation ($151,000)
- Alternative 3 - Excavation, Onsite Bioremediation, and Onsite Disposal ($224,000)

3.2.9 Selected Remedy

The Army has selected Alternative 6, Excavation and Offsite Asphalt Incorporation, as the preferred remedy for the contaminated soil at the Building 1003 Area. Based on the results presented in the RI/FS documents for the site, the State of California concurs with the selected remedy.

Alternative 6 will involve excavating all soil with TPH concentrations greater than 1,000 $\mu g/g$ (approximately 170 cy). This soil will be transported to a nearby asphalt batch plant for incorporation into asphalt.

The estimated present worth for Alternative 6 is $106,000. Table 3.8 presents the breakdown of the estimated costs for Alternative 6.

3.2.10 Statutory Determinations

The selected remedy satisfies statutory requirements of CERCLA § 121 and § 120(a)(4) such that the following mandates are satisfied:

- The selected remedy is protective of human health and the environment.
- The selected remedy complies with federal and state ARARs.
- The selected remedy is cost effective.
- The selected remedy utilizes permanent solutions and alternative treatment technologies or resource recovery technologies, to the maximum extent practicable.

Alternative 2 would reduce the mobility of motor oil constituents in this soil. Alternatives 3 and 5 would utilize active treatment (ex situ bioremediation and thermal desorption, respectively) to reduce the toxicity, mobility, and volume of soil contaminants. Alternatives 4 and 6 would reduce the mobility but not the toxicity or volume of soil contaminants.

3.2.8.5 Short-term Effectiveness

All of the alternatives are judged to offer a high degree of short-term effectiveness because of the lack of risk posed to the community and/or workers during the construction and implementation phase. Alternatives 2, 3, 4, 5, and 6 could potentially expose the community/workers by excavating contaminated soil. The community/workers could also be exposed during transportation of the soil to an offsite facility. However, any potential threat posed by soil excavation could be readily controlled by using appropriate dust control measures.

No significant adverse environmental impacts are anticipated from the construction and implementation of any of the alternatives. Alternatives 2, 3, 4, 5, and 6 would temporarily destroy the natural habitat of the site due to soil excavation activities.

3.2.8.6 Implementability

Alternative 1 (No Action) is the easiest alternative to implement. Alternatives 2, 3, 4, 5, and 6 would be slightly more difficult to implement because these alternatives require excavation and additional analyses to confirm that the excavated soil is not considered a hazardous waste. Alternative 4 (Excavation and On-base Reuse) may also be more difficult to implement because this alternative depends on the future need for road construction material at SIAD, which is currently unknown. Alternative 6 (Excavation and Offsite Asphalt Incorporation) could not be implemented during the winter months because the asphalt batch plants near SIAD do not operate during the winter.

3.2.8.7 Cost

The alternatives evaluated for the Building 1003 Area are presented below in order of increasing cost:

- Other Criteria, Advisories, or Guidance To Be Considered for this Remedial Action (TBCs)
  - The State of California has recommended that TPH concentrations in soil at the Building 1003 Area be reduced to below the 1,000 μg/g remediation level. The selected remedy, when complete, will have removed soil with TPH levels greater than 1,000 μg/g from the site.

3.2.10.3 Cost Effectiveness

The selected remedy, Alternative 6, utilizes cost-effective treatment for the type and volume of contaminants present. Although Alternative 6 will cost more than the no-action alternative, this alternative will satisfy the regulatory preference for active treatment, when practicable (40 Code of Federal Regulations [CFR] 300.430 (a)(1)(iii)(A)).

3.2.10.4 Utilization of Permanent Solutions and Alternative Treatment Technologies (or Resource Recovery Technologies) to the Maximum Extent Practicable

The selected remedy represents the maximum extent to which permanent solutions and treatment technologies can be utilized in a cost-effective manner for the final response action at the Building 1003 Area. This selected remedy provides the best balance of tradeoffs in terms of long-term effectiveness and permanence, reduction in mobility achieved through treatment, short-term effectiveness, implementability, cost, the statutory preference for treatment as a principal element, and considers California Environmental Protection Agency (Cal-EPA) and community acceptance.

The selected remedy offers a high degree of long-term effectiveness and permanence. It will significantly reduce the inherent hazards posed by the contaminated soil through permanent removal of soil contaminated with motor oil constituents from the site. The selected remedy can be implemented quickly and with little difficulty and is therefore assessed to be the most appropriate solution for the contaminated soil at the Building 1003 Area.

- The selected remedy satisfies the preference for treatment that reduces toxicity, mobility, and/or volume as a principal element.

3.2.10.1 Protection of Human Health and the Environment

The selected remedy protects human health and the environment through the permanent removal of soil contaminated with motor oil constituents from the site. By removing the contaminated soil, any potential risks to humans and ecological receptors would be mitigated. Furthermore, the potential for continued lateral migration of soil contaminants would be eliminated.

Section 3.2.8.5 discussed the short-term effectiveness of the evaluated alternatives. The selected remedy will not pose unacceptable short-term risks to human health or the environment during implementation.

3.2.10.2 Compliance with Applicable or Relevant and Appropriate Requirements

The selected remedy of excavation and offsite asphalt incorporation will comply with all applicable or relevant and appropriate chemical-, action-, and location-specific requirements (ARARs). The ARARs are presented below.

- Chemical-specific ARARs
  - None.
- Location-specific ARARs
  - None.
- Action-specific ARARs
  - California requirements for hazardous waste management in 22 CCR, Div. 4, Chapter 30, § 66001 et seq.
  - California and federal requirements for occupational health and safety in Labor Code, Div. 5, § 6300 et seq., and 29 USC §§ 651-678, respectively.
  - Federal DOT material shipment regulations, 49 CFR 100-180.

3.2.10.5 Preference for Treatment as a Principal Element

The selected remedy does not employ active treatment of the soil to reduce soil contaminant concentrations. However, incorporation of the excavated soil into asphalt will effectively immobilize the motor oil constituents.

3.3 Responsiveness Summary

The public comment period for the Proposed Plan for Nine Sites at SIAD began on February 7, 1996, and extended through March 7, 1996. No written comments were received by the Army or regulatory agencies. The public meeting presenting the Proposed Plan was held on February 22, 1996. Oral comments were received for the Building 1003 Area at the public meeting.

3.3.1 Community Preferences

At the public hearing, Ms. Geralyn Smith questioned whether the Army had considered employing a technique (such as using foam in the soil) that would allow for the affected soil to remain in place rather than be excavated, hauled, and disposed offsite. Mr. Wickham, Montgomery Watson, noted that in situ and other innovative technologies had been evaluated during the feasibility study and that they did not meet the cost-effectiveness criteria at this site. He also noted that the soil removed from the Building 1003 Area would be taken to a facility in the SIAD region for reuse as asphalt.

3.3.2 Integration of Comments

The Army evaluated in situ innovative technologies during conduct of the feasibility study for this site. Consideration was made regarding cost effectiveness, technical feasibility (effectiveness and implementability), and the ability for reuse of affected soil during the evaluation process. Excavation and asphalt incorporation were selected based on these criteria. The public's concern with offsite disposal is addressed by this technology, although excavation and hauling remain necessary components of the selected remedial action.

Table 3.2: Metals Above Background in Subsurface Soil - Building 1003 Area

	Concentration (µg/g [dry])									
	Certified Reporting Limits			USCS Soil Type for Individual Sample		All USCS Soil Types				
Compound	CRL*	CRL (JS11) (1990-1991)	CRL (JS16) (1992-1993)	Number of Samples Above Median	Number of Samples Above Maximum	Number of Samples Above Median	Number of Samples Above Maximum	Frequency of Detects	Minimum	Maximum
Arsenic	0.25	---	---	45/89	4/89	50/89	4/89	89/89	1.29	41.0
Antimony	---	3.80	7.14	16/89	16/89	16/89	16/89	16/89	<3.80	14.2
Barium	---	29.6	5.20	54/89	10/89	62/89	0/89	79/89	<29.6	560
Beryllium	---	1.86	0.500	4/89	4/89	4/89	4/89	4/89	<1.86	3.90
Cadmium	---	3.05	0.700	0/89	0/89	0/89	0/89	0/89	<3.05	<3.05
Chromium	---	12.7	4.05	0/89	0/89	0/89	0/89	0/89	<12.7	<12.7
Cobalt	---	15.0	1.42	NA	NA	NA	NA	NA	NA	NA
Copper	---	58.6	0.965	0/89	0/89	0/89	0/89	0/89	<58.6	<58.6
Lead	0.177	6.62	10.5	22/89	22/89	22/89	22/89	22/135	<6.62	19.8
Mercury	0.05	---	---	1/89	1/89	1/89	1/89	1/89	<0.05	0.162
Molybdenum	---	1.15	1.12	NA	NA	NA	NA	NA	NA	NA
Nickel	---	12.6	1.71	0/89	0/89	0/89	0/89	0/89	<12.6	<12.6
Selenium	0.25	---	---	0/89	0/89	0/89	0/89	0/89	<0.25	<0.25
Silver	---	2.50	0.589	0/89	0/89	0/89	0/89	0/89	<2.50	<2.50
Thallium	---	31.3	6.623	3/89	3/89	3/89	3/89	3/89	<31.3	77.4
Vanadium	---	13.0	3.39	NA	NA	NA	NA	NA	NA	NA
Zinc	---	30.2	8.03	22/89	16/89	22/89	10/89	22/89	<30.2	141

µg/g Micrograms per gram
USCS Unified soil classification system

* Certified reporting limit (CRL) for analyses other than USAEC Methods JS11 and JS16.

Table 3.1: Metals Above Background in Surface Soil - Building 1003 Area

	Concentration (µg/g [dry])									
	Certified Reporting Limits			Soil Type 312 and 313		All Soil Types				
Compound	CRL*	CRL (JS11) (1990-1991)	CRL (JS16) (1992-1993)	Number of Samples Above Median	Number of Samples Above Maximum	Number of Samples Above Median	Number of Samples Above Maximum	Frequency of Detects	Minimum	Maximum
Arsenic	0.25	---	---	19/19	16/19	19/19	0/19	19/19	4.57	10.2
Antimony	---	3.80	7.14	1/19	1/19	1/19	1/19	1/19	<3.80	10.3
Barium	---	29.6	5.20	19/19	8/19	3/19	0/19	19/19	125	410
Beryllium	---	1.86	0.500	0/19	0/19	0/19	0/19	0/19	<1.86	<1.86
Cadmium	---	3.05	0.700	0/19	0/19	0/19	0/19	0/19	<3.05	<3.05
Chromium	---	12.7	4.05	1/19	1/19	1/19	1/19	1/19	<12.7	27.6
Cobalt	---	15.0	1.42	NA	NA	NA	NA	NA	NA	NA
Copper	---	58.6	0.965	0/19	0/19	0/19	0/19	0/19	<58.6	<58.6
Lead	0.177	6.62	10.5	27/35	26/35	27/35	20/35	27/35	<6.62	175
Mercury	0.05	---	---	2/19	2/19	2/19	2/19	2/19	<0.05	0.092
Molybdenum	---	1.15	1.12	NA	NA	NA	NA	NA	NA	NA
Nickel	---	12.6	1.71	0/19	0/19	0/19	0/19	0/19	<12.6	<12.6
Selenium	0.25	---	---	0/19	0/19	0/19	0/19	0/19	<0.25	<0.25
Silver	---	2.50	0.589	0/19	0/19	0/19	0/19	0/19	<2.50	<2.50
Thallium	---	31.3	6.623	0/19	0/19	0/19	0/19	0/19	<31.3	<31.3
Vanadium	---	13.0	3.39	NA	NA	NA	NA	NA	NA	NA
Zinc	---	30.2	8.03	8/19	8/19	8/19	6/19	8/19	<30.2	228

µg/g Micrograms per gram

* Certified reporting limit (CRL) for analyses other than USAEC Methods JS11 and JS16.

Table 3.4: Summary of Background Groundwater Samples for Sierra Army Depot

Compound	CRL (SS10)	CRL (others)	DSB-04-MWA				BKG-01-MWA				BKG-02-MWA				Frequency of Detects	Minimum	Maximum	Median
			3/10/92	5/11/92	10/26/93	1/24/94	4/8/92	5/8/92	10/26/93	1/24/93	4/22/92	5/10/92	10/26/93	1/24/94				
Arsenic	---	2.54	287	257	240	290	5.53	7.36	5.01*	4.37	6.40	8.42	5.54*	5.01	12/12	4.37‡	290	6.40*
Antimony	38.0	3.03	<38.0	<38.0	6.80#	<6.10	<38.0	<38.0	3.57#	9.29#	<38.0	<38.0	<3.03	12.6#	4/12	<3.03	12.6#	<38.0
Barium	5.00	---	21.4	14.2	14.4	14.4	23.6	24.8	28.9	26.1	15.6	16.4	16.3	15.8	12/12	14.2	28.9	16.3
Beryllium	5.00	---	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	0/12	<5.00	<5.00	<5.00
Cadmium	4.01	---	<4.01	<4.01	<4.01	<4.010	<4.01	<4.01	<4.01	<4.01	<4.01	<4.01	<4.01	<4.01	0/12	<4.01	<4.01	<4.01
Calcium	500	---	146000	203000	183000	128000	111000	115000	125000	108000	114000	122000	122000	117000	12/12	111000	203000	122000
Chromium	6.02	---	<6.02	<6.02	<6.02	<6.02	<6.02	<6.02	<6.02	<6.02	<6.02	<6.02	<6.02	<6.02	0/12	<6.02	<6.02	<6.02
Cobalt	25.0	---	NA	NA	<25.0	<25.0	NA	NA	<25.0	<25.0	NA	NA	<25.0	<25.0	0/6	<25.0	<25.0	<25.0
Copper	8.09	---	<8.09	<8.09	<8.09	<8.09	<8.09	<8.09	<8.09	<8.09	<8.09	<8.09	<8.09	<8.09	0/12	<8.09	<8.09	<8.09
Lead	18.6	1.26	<1.26	<1.26	<1.26	<1.26	1.84	<1.26	<1.26	<1.26	<1.26	<1.84	<1.26	<1.26	2/12	<1.26	1.84	<1.26
Mercury	---	0.243	<0.243	<0.243	<0.243	<0.243	<0.243	<0.243	<0.243	<0.243	<0.243	<0.243	<0.243	<0.243	0/12	<0.243	<0.243	<0.243
Molybdenum	15.3	---	NA	NA	824	660	NA	NA	<15.3	<15.3	NA	NA	25.3	26.7	4/6	<15.3	824.000	25.3
Nickel	34.3	---	<34.3	<34.3	<34.3	<34.3	<34.3	<34.3	<34.3	<34.3	<34.3	<34.3	<34.3	<34.3	0/12	<34.3	<34.3	<34.3
Selenium	71.1	3.02	<12.0	<3.02	<6.00	<3.02	10.2	8.63	6.50	7.56	<3.02	<3.02	<3.02	<3.02	4/12	<3.02	10.2	<3.02
Silver	4.60	0.250	0.689	0.420	<4.60	<4.60	<0.250	<0.250	<4.60	<4.60	<0.250	<0.250	<4.60	4.60	2/12	<0.250	0.689	<4.60
Sodium	500	---	2180000	2640000	2360000	2300000	46200	46300	49700	48800	208000	213000	207000	210000	12/12	46200	2640000	208000
Thallium	---	6.99	<6.99	<6.99	<6.99	<6.99	<6.99	<6.99	<6.99	<6.99	<6.99	<6.99	<6.99	<6.99	0/12	<6.99	<6.99	<6.99
Vanadium	11.0	---	NA	NA	22.7	36.3	NA	NA	12.2	<11.0	NA	NA	23.7	18.0	5/6	<11.0	36.3	18.0
Zinc	21.1	---	<21.1	<21.1	116	<21.1	<21.1	<21.1	105	<21.1	<21.1	<21.1	117	74.0	4/12	<21.1	117	<21.1

All groundwater samples were filtered prior to analysis

Concentrations are in micrograms per liter ($\mu g/l$)

CRL Certified reporting limit

* These concentrations are estimated due to the presence of arsenic in the filter blank associated with these samples at a concentration of 3.2 $\mu g/l$.
\# These concentrations are qualified as non-detect due to the presence of antimony in the filter blanks associated with these samples at concentrations ranging from 7.7 $\mu g/l$ to 8.8 $\mu g/l$.

12299 14.02.00
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Table 3.3: Summary of Compounds Detected in Groundwater - Building 1003 Area

Analyte	State MCL	Federal MCL	CRL	Concentrations in µg/l Round 1	Round 2	Round 3	Round 4	Round 5	Round 6
BU1-01-MWA				**4/24/91**	**7/20/91**	**2/23/92**	**4/23/92**	**10/16/93**	**1/18/94**
Organic Compounds									
Methylene Chloride	NA	NA	2.3	ND	3.68	ND	ND	ND	ND
TCE	5	5	0.5	ND	ND	ND	ND	ND	1.4
bis(2-ethylhexyl)phthalate	4	6		ND	4.45	ND	ND	ND	ND
Metals[a]									
Barium	1,000	2,000	5	38.1	35.8	41.0	40.4	NA	NA
Copper	NA	1,000	8.09	9.57	ND	ND	ND	NA	NA
Lead	50	15	1.26	24.5	ND	ND	ND	ND	ND
Selenium	10	50	3.02	ND	16.6	16.7	18.4	NA	NA
Silver	50	100	0.25	0.745	ND	ND	ND	NA	NA
Nitrite, nitrate	45,000[b]	1,000[c]	10	NA	NA	NA	NA	NA	55,000
BU1-01-HP				-	-	-	-	-	**8/30/93**
Organic Compounds				NA	NA	NA	NA	NA	ND
Metals									
Lead	50	NA	1.26	NA	NA	NA	NA	NA	ND
BU1-02-HP				-	-	-	-	-	**8/31/93**
Organic Compounds				NA	NA	NA	NA	NA	ND
Metals									
Lead	50	NA	1.26	NA	NA	NA	NA	NA	ND
BU1-03-HP				-	-	-	-	-	**8/24/93**
Organic Compounds				NA	NA	NA	NA	NA	ND
Metals									
Lead	50	NA	1.26	NA	NA	NA	NA	NA	ND
BU1-04-HP				-	-	-	-	-	**9/6/93**
Organic Compounds									
Methyl ethyl ketone	NA	NA	6.4	NA	NA	NA	NA	NA	30.0
Metals									
Lead	50	NA	1.26	NA	NA	NA	NA	NA	ND

CRL Certified reporting limit
MCL Maximum contaminant level
MRL Method reporting limit
NA Not analyzed/not applicable
ND Not detected
TCE Trichloroethene
µg/l Micrograms per liter

a. Metal concentrations detected in monitoring well BU1-01-MWA above SIAD background levels.
b. California MCL for nitrate
c. Federal MCL for nitrite as N. Federal MCL for nitrate as N = 10,000 µg/l

Table 3.6: Applicable or Relevant and Appropriate Federal Requirements for Sierra Army Depot

Standard, Requirement, Criterion, or Limitation	Citation	Description	Applicable or Relevant and Appropriate	Comment
Action-Specific				
Occupational Safety and Health Act	29 USC §§ 651-678	Regulates worker health and safety	Applicable	Under 40 CFR § 300.38, requirements of the Act apply to all response activities under the NCP.
Department of Transportation Material Shipment Regulations	49 CFR 100-180	Regulates the packaging, labeling, and shipping of hazardous materials	Applicable	Department of Transportation requirements apply to all shipments of hazardous materials.

CFR Code of Federal Regulations
NCP National Contingency Plan
USC United States Code

Table 3.5: Summary of Multipathway Exposures at the Building 1003 Area

Exposure Scenario/Exposure Pathway	Hazard Index	Excess Lifetime Cancer Risk
Current Baseworker		
Soil exposure	0.035	1.6E-05
Current and Future Construction Worker		
Surface soil exposure	0.14	3.3E-06
Subsurface soil exposure	0.65	1.2E-05
Current Casual Visitor		
Surface soil exposure	0.011	2.0E-06
Hypothetical Future Adult Resident		
Soil exposure	0.067	3.6E-05
Groundwater exposure	4.3	2.3E-03
Hypothetical Future Child Resident		
Soil exposure	0.5	6.8E-05
Groundwater exposure	10	1.3E-03

Table 3.7: Applicable or Relevant and Appropriate California Requirements for Sierra Army Depot (continued)

Standard, Requirement, Criterion, or Limitation	Citation	Description	Applicable or Relevant and Appropriate	Comment
Health and Safety Standards for Management of Hazardous Waste (continued)	CCR, Title 22, Div. 4.5, Chapt. 14, Art. 9, §§ 66264.170-66264.178	Applies to owners and operators who store hazardous waste for more than 90 days in containers. Covers use and management of containers, containment, inspections, and closure.	Relevant and Appropriate	CA Regulatory Agency: DTSC

Table 3.7: Applicable or Relevant and Appropriate California Requirements for Sierra Army Depot

Standard, Requirement, Criterion, or Limitation	Citation	Description	Applicable or Relevant and Appropriate	Comment
Mulford-Carrell Air Resources Act	H & S Code, Div. 26, § 39000 et seq. CCR, Title 17, Part III, Chapter 1, § 60000 et seq.	Regulates both nonvehicular and vehicular sources of air contaminants in California. Defines relationships of the California Air Resources Board (ARB) and local or regional air pollution control districts (APCDs). Establishes emission limitations.	Applicable	The local APCD sets allowable emission limits. Emission limits will need to be established for emissions associated with specific remedial alternatives. SIAD is located in Lassen County. Applicable air quality regulations are specified in the Lassen County Air Pollution Control District's Air Pollution Regulations. The Lassen County APCD determines emission limits on a site-specific basis. CA Regulatory Agency: ARB; Lassen County APCD
Hazardous Waste Control Laws	H & S Code, Div. 20, Chapters 6.5 and 6.8, § 25100 et seq. CCR Title 22, Div. 4.5, Chapter 10, § 66001 et seq.	Regulations governing hazardous waste control; management and control of hazardous waste facilities; transportation; laboratories; classification of extremely hazardous, hazardous, and nonhazardous waste. Includes STLCs and TTLCs.	Applicable or relevant and appropriate	State hazardous waste control laws are considered applicable or relevant and appropriate operating standards for those alternatives involving treatment and disposal of hazardous wastes. CA Regulatory Agency: Department of Toxic Substances Control (DTSC).
Identification and Listing of Hazardous Waste (Hazardous Substance Act)	CCR, Title 22, Div. 4.5, Chapter 11, § 66261 et seq.	Definitions and characteristics of waste, hazardous waste, RCRA hazardous waste and special waste. Labeling requirements.	Applicable	This Act applies to ongoing operations of a facility that generates or manages hazardous waste. CA Regulatory Agency: DTSC
Health and Safety Standards for Management of Hazardous Waste	CCR, Title 22, Div. 4.5, Chapt. 14, Art. 16, §§ 66264.600-66264.603	Applies to owners and operators of facilities that treat, store or dispose of RCRA hazardous waste in miscellaneous units. Covers environmental performance standards, monitoring, inspections, and post-closure care.	Relevant and Appropriate	Some of the alternatives will utilize treatment systems that are considered miscellaneous units. CA Regulatory Agency: DTSC

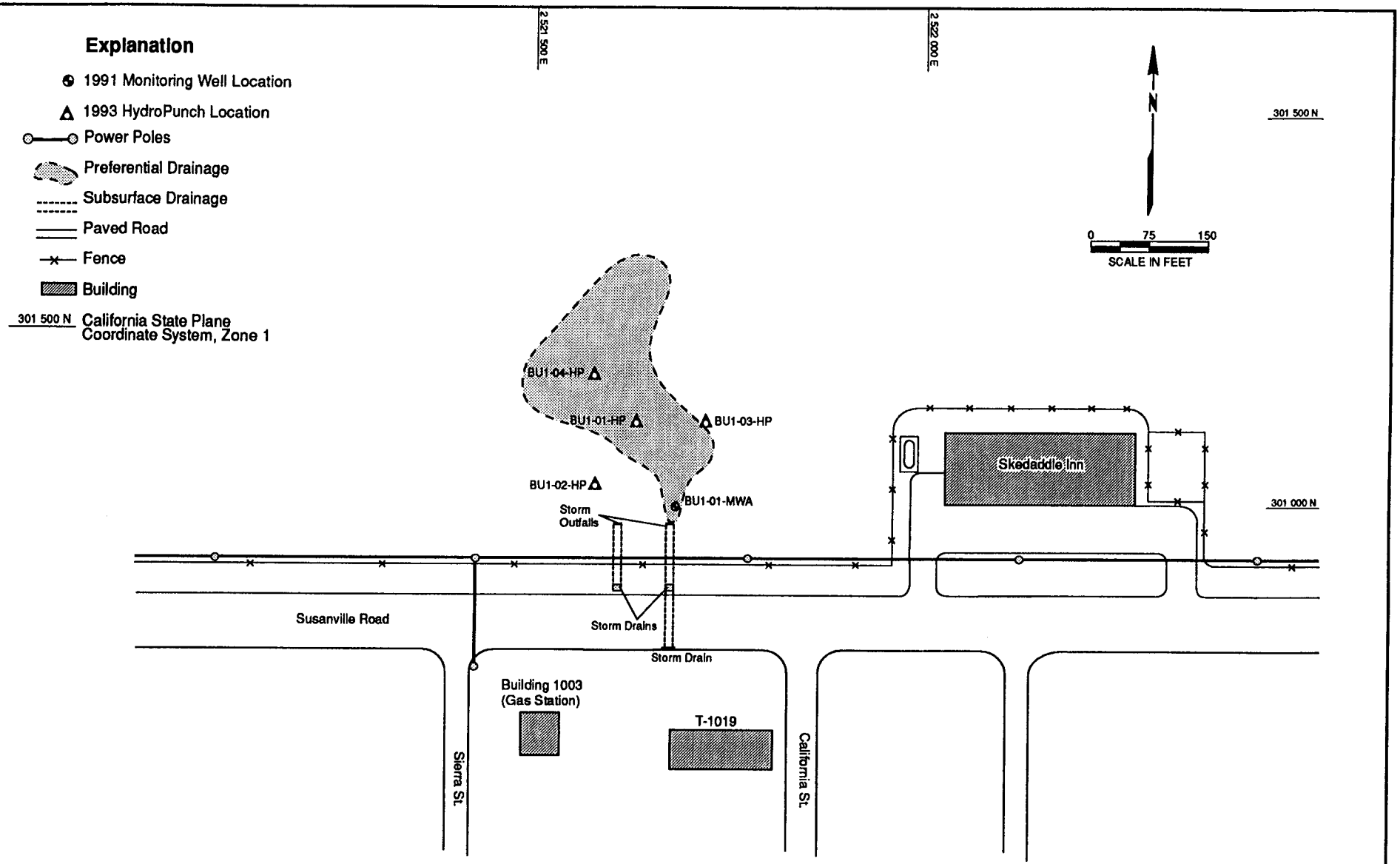
Table 3.8: Estimated Cost for Excavation and Offsite Asphalt Incorporation
Building 1003 Area
(continued)

STLC	Soluble threshold limit concentration
TPH	Total petroleum hydrocarbons
TTLC	Total threshold limit concentration
VOCs	Volatile organic compounds

a. Individual costs are rounded to the nearest one hundred dollars.
b. Two-person crew (one senior and one professional), 2 days, 12-hour days.
c. Excavation consists of three trenches: 20 feet x 30 feet x 1 foot, 20 feet x 20 feet x 1 foot, and 20 feet x 20 feet x 9 feet. It is assumed that shoring would not be required.
d. Assume five samples collected and analyzed for TPH (modified 8015).
e. Price quoted by Tahoe Asphalt Co., South Lake Tahoe, California. Actual fee for asphalt batch plant in Doyle, California, was not available. Soil profiling includes analyses for VOCs, TPH, TTLC metals, STLC lead, aquatic bioassay. One soil sample per 250 cubic yards is assumed.
f. For this alternative, it is assumed no operating costs are incurred after the removal action is implemented.
g. Total cost is rounded to nearest one thousand dollars.

Table 3.8: Estimated Cost for Excavation and Offsite Asphalt Incorporation Building 1003 Area

Item/Description	Unit	Unit Cost	Quantity	Subtotal[a]	Total
Soil Excavation					
Engineering Oversight[b]	Hour	$130	24	$3,100	
Health and Safety Plan	Lump sum	$5,000	1	$5,000	
Mobilization and Demobilization	Lump sum	$4,000	1	$4,000	
Site Clearing	Square foot	$0.20	1,400	$300	
Excavation[c]	Cubic yard	$15	170	$2,600	
Total					$15,000
Post Excavation Sampling[d]					
Sampling					
Personnel	Hour	$60	8	$500	
Sampling Equipment	Lump sum	$500	1	$500	
Analyses	Sample	$127	5	$635	
Total					$1,600
Disposal					
Transport to recycling facility in Doyle, California	Load of 23 tons	$115	10	$1,150	
Recycling Fee[e]	Ton	$45	220	$9,900	
Profiling Soil[e]	Sample	$1,220	1	$1,200	
Total					$12,300
Demobilization					
Imported Fill	Cubic yard	$17	170	$2,900	
Backfilling and compaction	Cubic yard	$11	170	$1,900	
Total					$4,800
Closure Report	Lump sum	$12,000	1	$12,000	
Total					$12,000
Capital Cost Subtotal					**$45,700**
Plan and Specification Preparation (7.5% of Capital Costs or $25,000, whichever is greater)					$25,000
Bid Preparation and Evaluation (2.5% of Capital Costs or $15,000, whichever is greater)					$15,000
Contingency (30% of Operating and Capital Costs)[f]					$13,700
Project Administration (15% of Operating and Capital Costs)[f]					$6,900
TOTAL COST OF REMEDIAL ALTERNATIVE[g]					**$106,000**



SRA 1071.1 11/3/95 ECS

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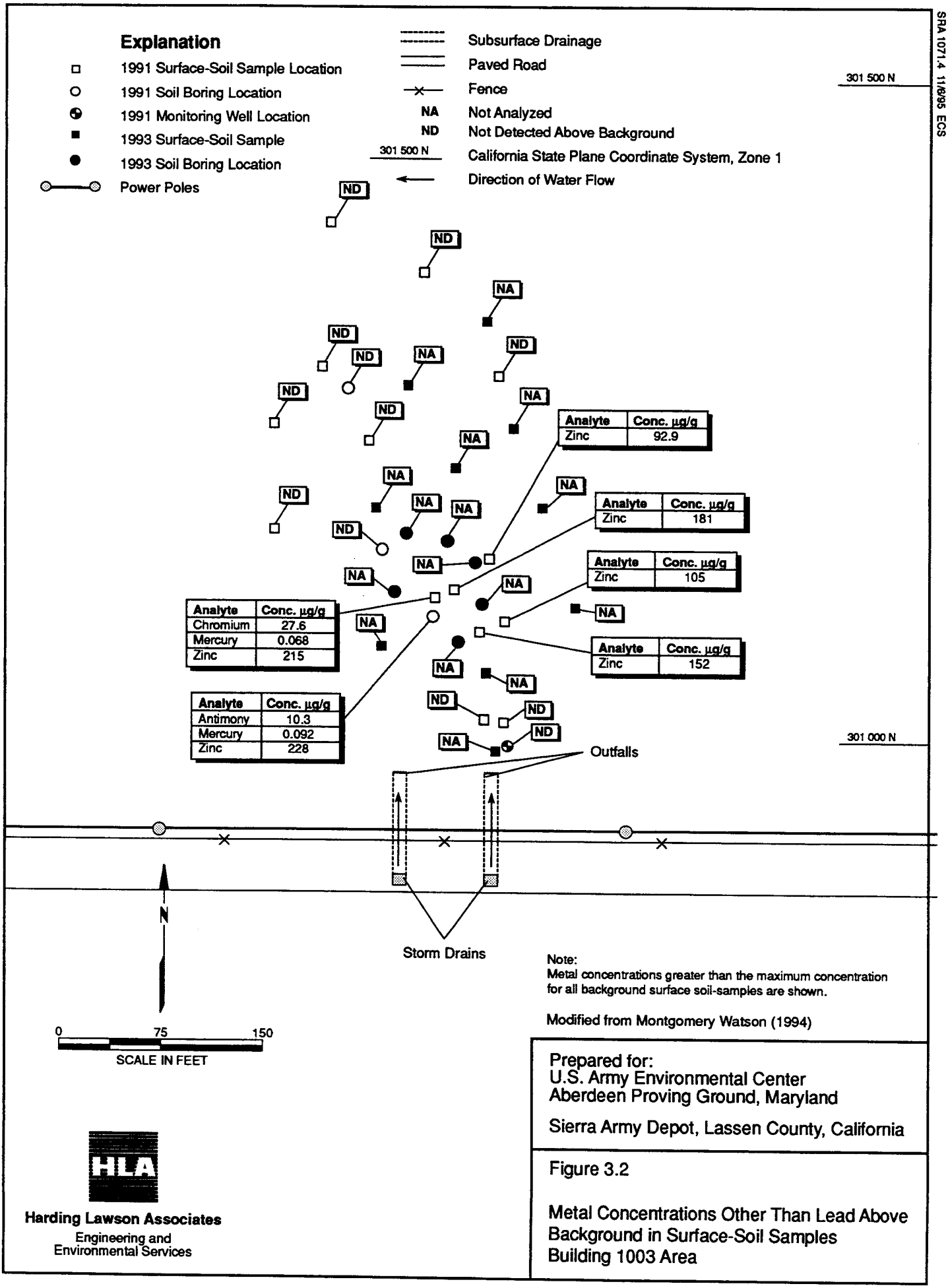
Engineering and Environmental Services

Prepared for:
U.S. Army Environmental Center
Aberdeen Proving Ground, Maryland

Sierra Army Depot, Lassen County, California

Figure 3.1

Site Map
Building 1003 Area



Note:
Metal concentrations greater than the maximum concentration for all background surface soil-samples are shown.

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Figure 3.2

Metal Concentrations Other Than Lead Above Background in Surface-Soil Samples
Building 1003 Area

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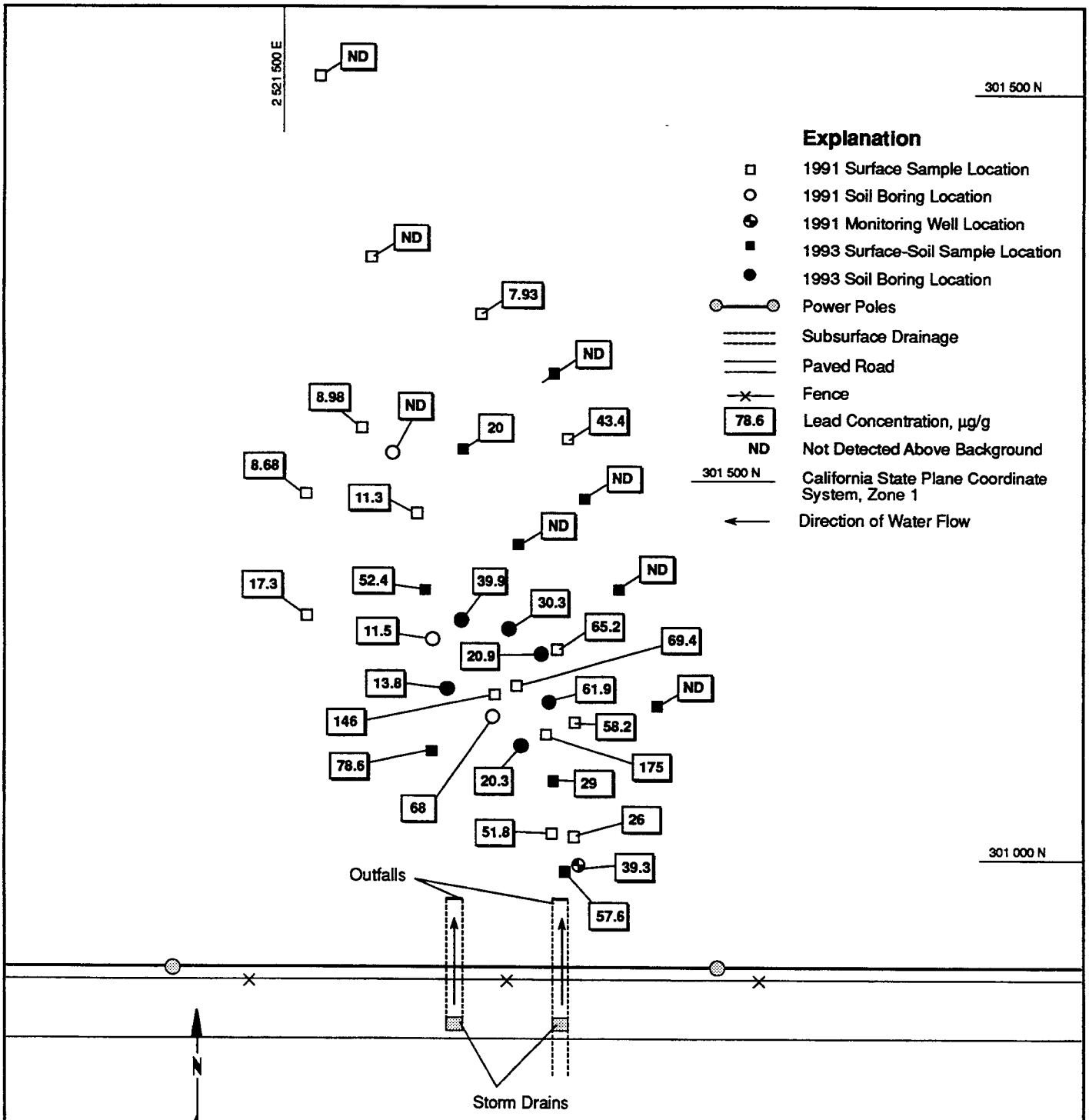

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Figure 3.3

Lead Concentrations in Surface-Soil Samples
Building 1003 Area

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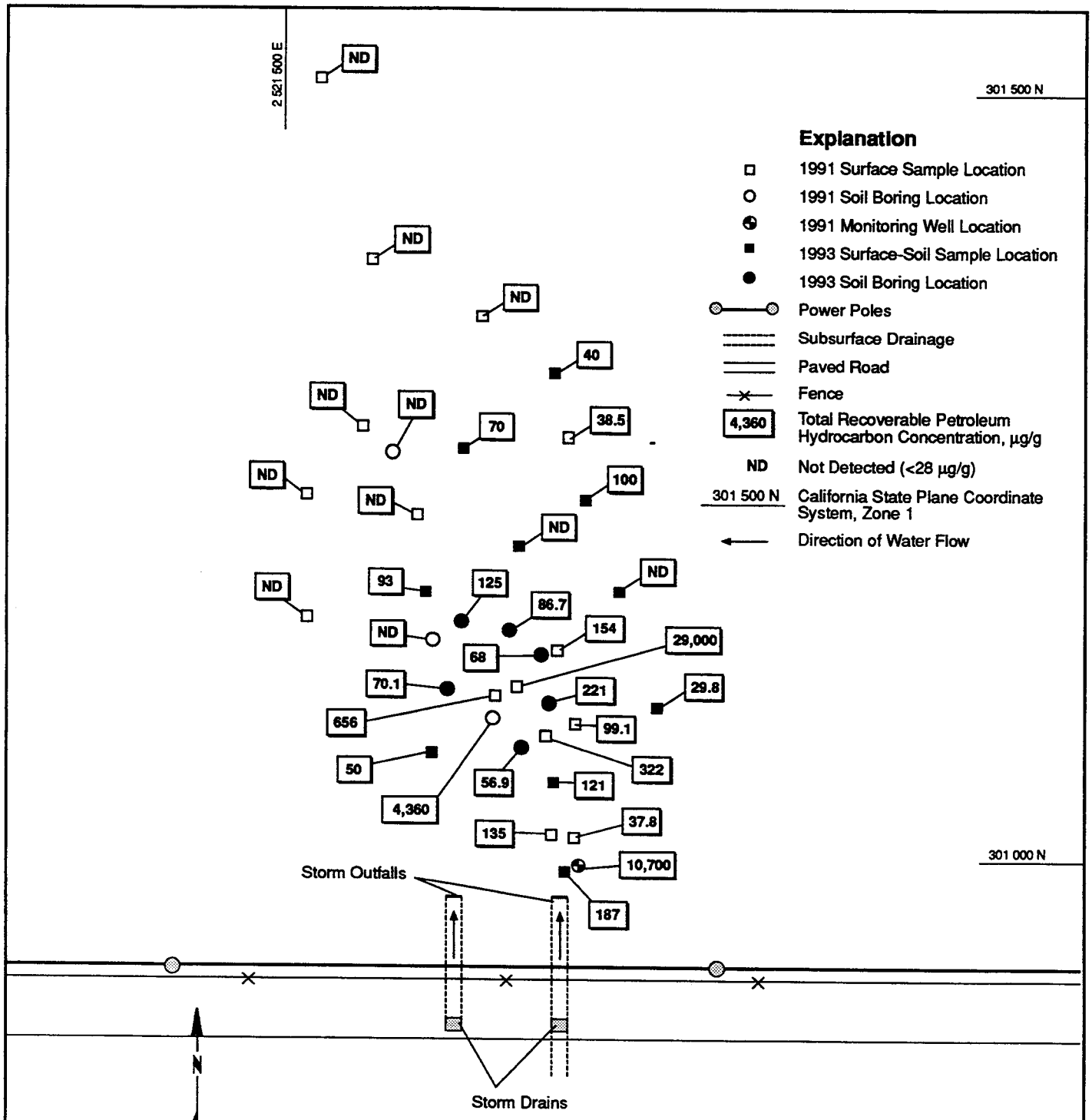

SRA 1071.7 12/4/95 ECS

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Figure 3.4

Total Recoverable Petroleum Hydrocarbon Concentrations in Surface-Soil Samples Building 1003 Area

HLA

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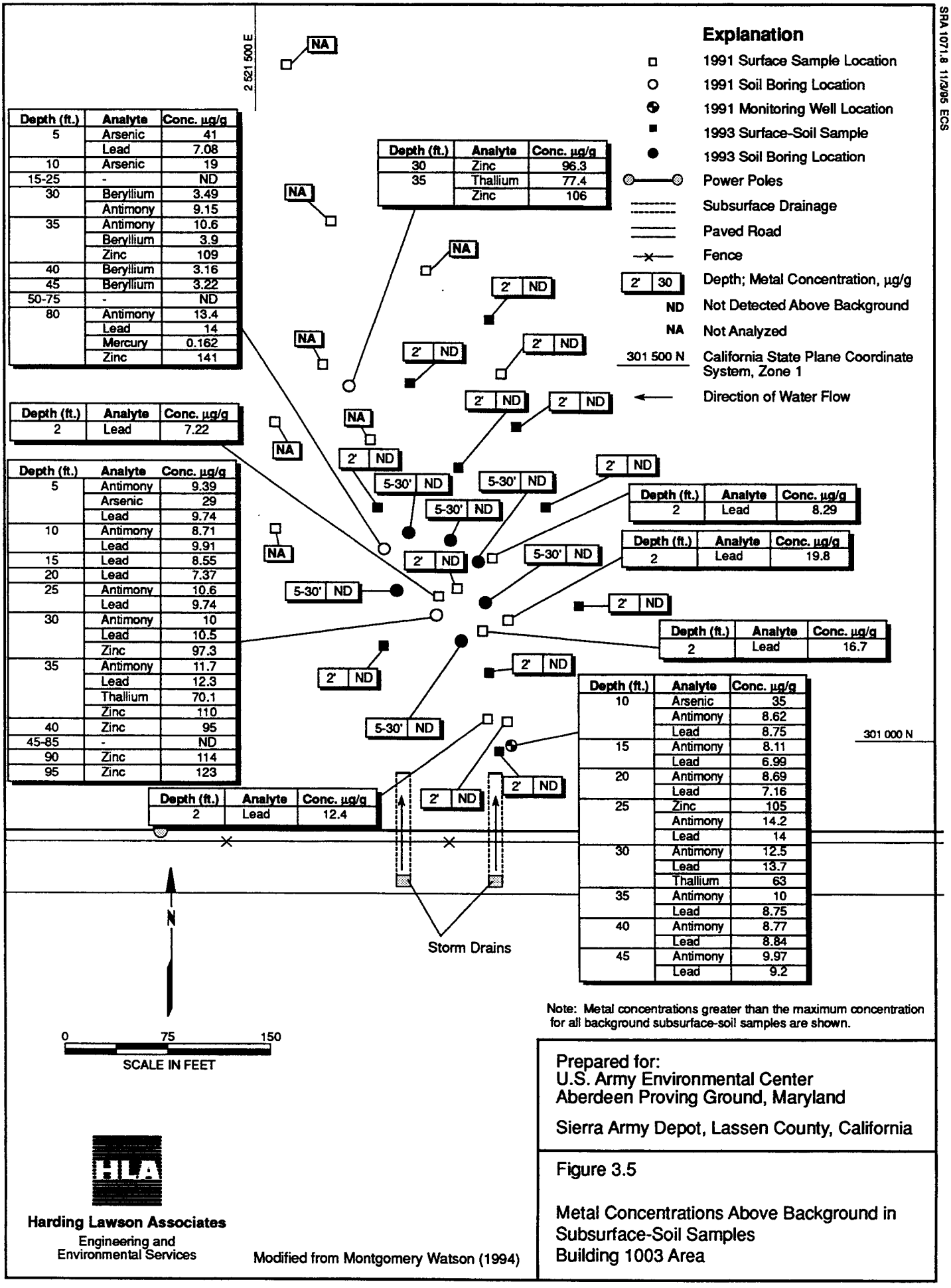

Depth (ft.)	Analyte	Conc. µg/g
5	Arsenic	41
	Lead	7.08
10	Arsenic	19
15-25	-	ND
30	Beryllium	3.49
	Antimony	9.15
35	Antimony	10.6
	Beryllium	3.9
	Zinc	109
40	Beryllium	3.16
45	Beryllium	3.22
50-75	-	ND
80	Antimony	13.4
	Lead	14
	Mercury	0.162
	Zinc	141

Depth (ft.)	Analyte	Conc. µg/g
30	Zinc	96.3
35	Thallium	77.4
	Zinc	106

Depth (ft.)	Analyte	Conc. µg/g
2	Lead	7.22

Depth (ft.)	Analyte	Conc. µg/g
5	Antimony	9.39
	Arsenic	29
	Lead	9.74
10	Antimony	8.71
	Lead	9.91
15	Lead	8.55
20	Lead	7.37
25	Antimony	10.6
	Lead	9.74
30	Antimony	10
	Lead	10.5
	Zinc	97.3
35	Antimony	11.7
	Lead	12.3
	Thallium	70.1
	Zinc	110
40	Zinc	95
45-85	-	ND
90	Zinc	114
95	Zinc	123

Depth (ft.)	Analyte	Conc. µg/g
2	Lead	8.29

Depth (ft.)	Analyte	Conc. µg/g
2	Lead	19.8

Depth (ft.)	Analyte	Conc. µg/g
2	Lead	16.7

Depth (ft.)	Analyte	Conc. µg/g
2	Lead	12.4

Depth (ft.)	Analyte	Conc. µg/g
10	Arsenic	35
	Antimony	8.62
	Lead	8.75
15	Antimony	8.11
	Lead	6.99
20	Antimony	8.69
	Lead	7.16
25	Zinc	105
	Antimony	14.2
	Lead	14
30	Antimony	12.5
	Lead	13.7
	Thallium	63
35	Antimony	10
	Lead	8.75
40	Antimony	8.77
	Lead	8.84
45	Antimony	9.97
	Lead	9.2

Note: Metal concentrations greater than the maximum concentration for all background subsurface-soil samples are shown.

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Figure 3.5

Metal Concentrations Above Background in Subsurface-Soil Samples
Building 1003 Area

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Modified from Montgomery Watson (1994)

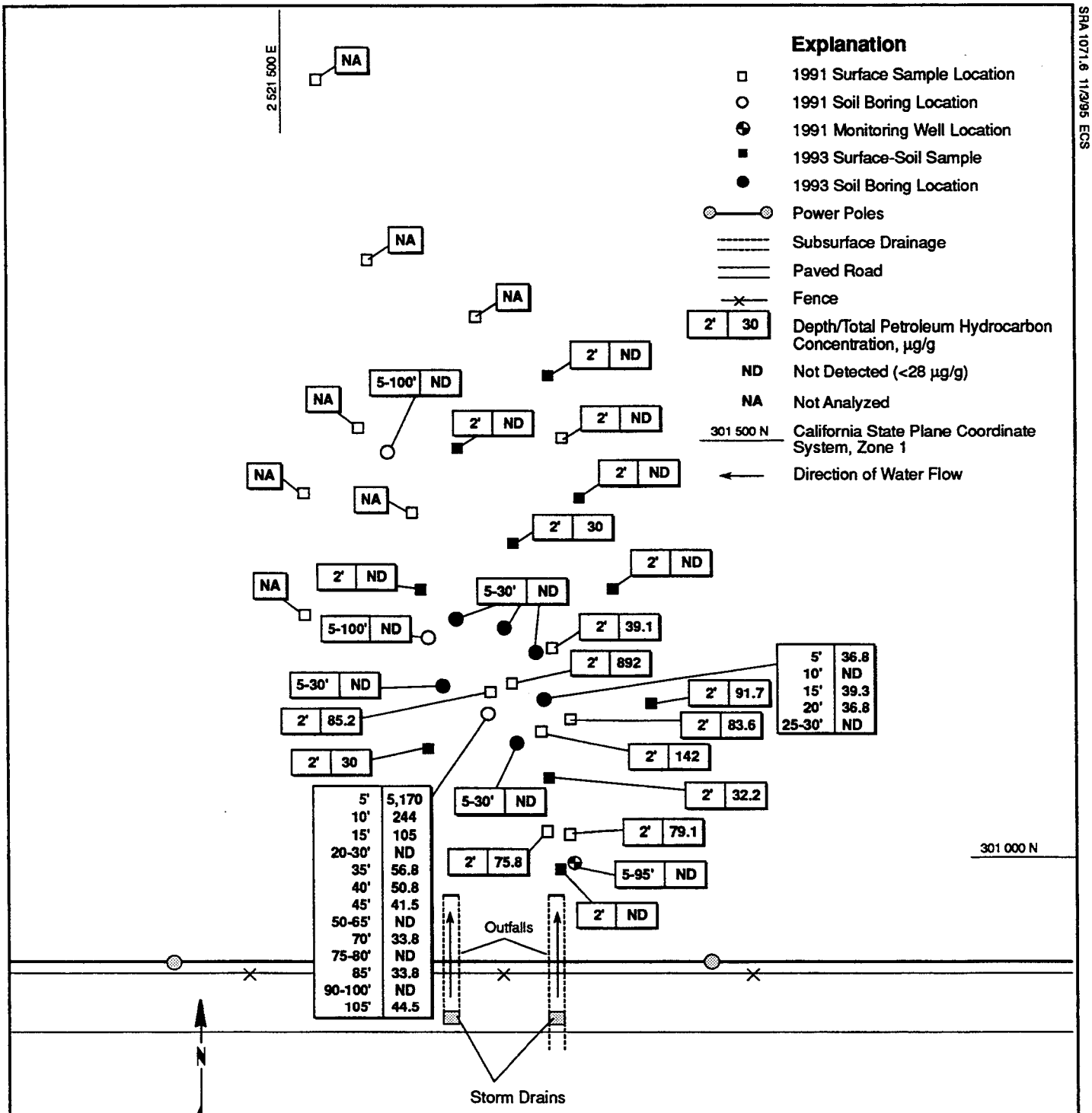

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Figure 3.6

Total Recoverable Petroleum Hydrocarbon Concentrations in Subsurface-Soil Samples Building 1003 Area

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